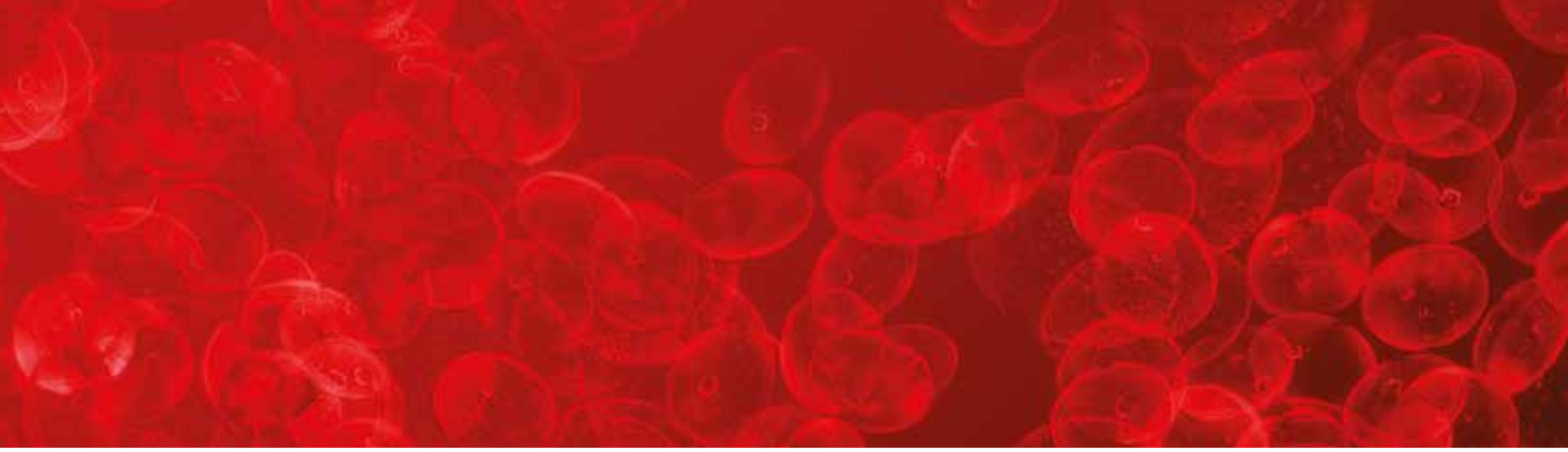
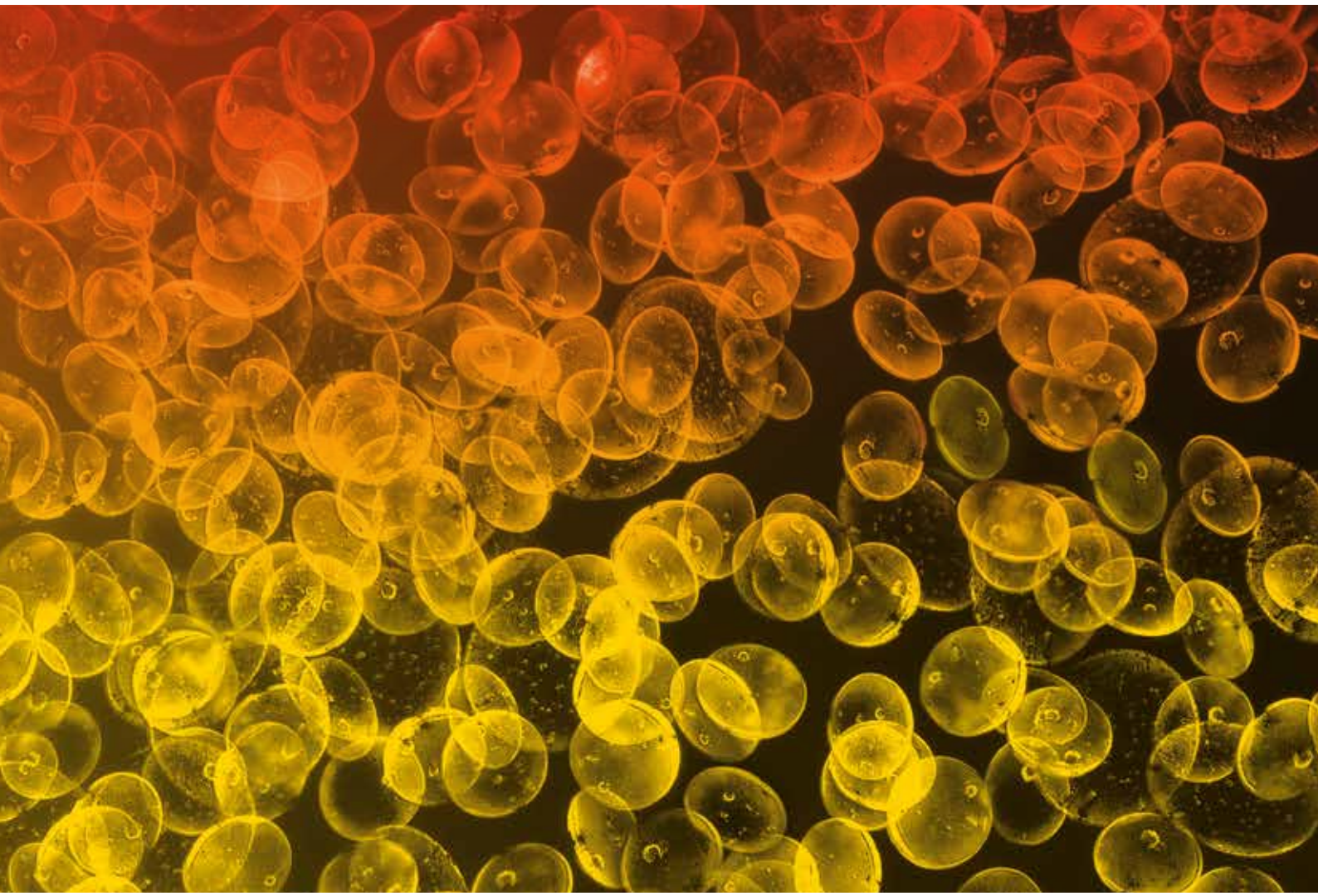


ANNUAL SHOT REPORT 2014

Affiliated to the Royal College of Pathologists

The Steering Group includes members representing the following professional bodies:

British Blood Transfusion Society
British Society for Haematology
British Society of Gastroenterology
British Committee for Standards in Haematology
Faculty of Public Health
Institute of Biomedical Science
Public Health England
Royal College of Anaesthetists
Royal College of Nursing
Royal College of Midwives
Royal College of Obstetricians and Gynaecologists
Royal College of Physicians
Royal College of Surgeons
Royal College of Paediatrics and Child Health
Intensive Care Society
Faculty of Intensive Care Medicine
The College of Emergency Medicine
Defence Medical Services
UK Forum



MHRA

working with

SERIOUS HAZARDS OF TRANSFUSION SHOT

Serious Hazards of Transfusion (SHOT)

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Ms Nina Vinall	Expertise in Patient Safety

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Cases from the Annual SHOT Report

General SHOT resources

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1 Foreword

Welcome to the SHOT report for incidents reported from across the United Kingdom in 2014. 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 with fewer deaths related to transfusion reported in 2014 than in 2013. We are working towards a closer alignment with the Medicines and Healthcare products Regulatory Agency (MHRA) and reporting to the European Union (EU) following recognition that many SARs reported to SHOT only, should also have been reported to the MHRA. During 2015 the SHOT Working Expert Group (WEG) will take over analysis of all the adverse reactions and will forward to the MHRA those that require inclusion in the returns to the EU.

We have introduced some changes in the format of this report. We have made only two recommendations, a revision to the previous recommentation about transfusion at night, see Chapter 5, and one relating to the use of male plasma for cryoprecipitate to further reduce the risk of transfusion-related acute lung injury, in Chapter 27. We have put other key messages as headlines at the top of the chapters. In addition, some topics will only be found on the SHOT website: those where reports are few and there are no new observations. These 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) and incidents related to anti-D immunoglobulin administration (anti-D). Overall, the direction of travel for future SHOT reports will be towards electronic publishing, but we recognise that not all hospital staff have easy access to the internet and many value the hard copy which will continue to be produced for the moment, but in smaller numbers.

Following the continued observation that the majority of reports follow mistakes (often multiple) in the transfusion process (77.8%) we have included a chapter on human factors to examine some of these. The mistakes are grouped under subheadings (identification, communication and documentation) but also we have observed a worrying number of adverse reactions and events related to poor clinical decisions. Laboratory errors have not decreased and there are concerns that local investigations and root cause analyses are not being fully completed. The number of reports with an information technology (IT) element has increased and is a reminder that IT should be set up and used correctly.

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

Participation in UK Haemovigilance Reporting 2

Authors: Debbi Poles and Paula Bolton-Maggs

Calendar year participation 2014

The total number of reports made to the Medicines and Healthcare products Regulatory Agency (MHRA) online reporting system, Serious Adverse Blood Reactions and Events (SABRE) from 1st January 2014 to December 31st 2014 was 3825.

Of these reports 3668/3825 (95.9%) were marked as 'SHOT only' or were shared with SHOT and initiated a new record on the SHOT online reporting system (Dendrite) for the additional SHOT questionnaires to be completed. This compared to 3568 reports to SHOT in 2013, an increase of 2.8%.

Notification reports made to the MHRA as serious adverse events (SAE) or serious adverse reactions (SAR) during 2014 were 1346/3825 (35.2%), an increase of 5.0% from 1282 in 2013. This includes cases that were subsequently withdrawn.

The difference in numbers reported to each organisation can mostly be explained by the difference in reporting criteria, for example alloimmunisation, anti-D immunoglobulin errors and 'wrong blood in tube' errors are outside the scope of the European Union (EU) legislation and so are not reportable to the MHRA.

However, following a detailed reconciliation of 2013 report data between the 2 organisations, it became apparent that there was also some underreporting of SARs to the MHRA. This analysis identified 192 reaction reports to SHOT that were not reported as SARs to the MHRA. Based on the initial brief description in the SHOT report, 98/192 (51.0%) should definitely have been reported to the MHRA as well, while another 30/192 (15.6%) were probably reportable but would require further information from the reporter (Poles et al. 2014).

Further to this work, SHOT and the MHRA are working closely together to streamline the process of SAR reporting to ensure that all reactions are reported appropriately to fulfil the requirements of the EU legislation.

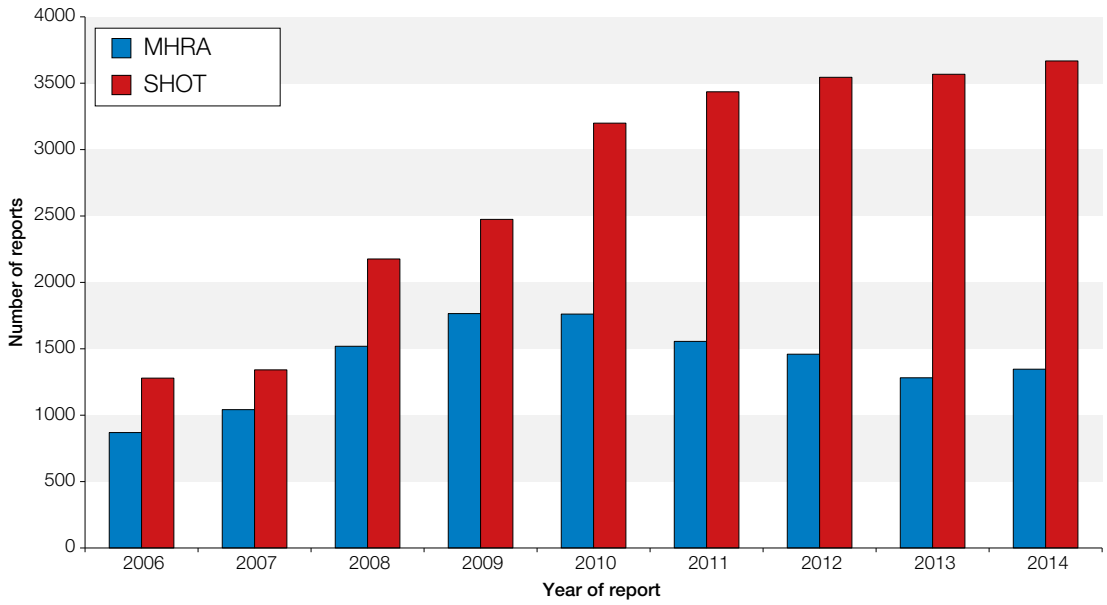


Figure 2.1: Reporting levels for MHRA and SHOT 2006-2014

Reporting organisations 2014

Participation remains high, with 100% of NHS organisations either registered to report to SHOT, or reporting through another registered organisation. There were 7 non-reporting National Health Service (NHS) Trusts/Health Boards in 2014. These included 3 very low users (based on the 2013 SHOT benchmarking data usage categories), 2 low users, and 2 medium users. The 2 medium sized non-reporting organisations had both made initial reports during 2012 and 2013, but most of these were subsequently withdrawn when the reporters did not complete the questionnaires. This could suggest an issue with the reporting arrangements in those organisations.

There were 21 non-NHS organisations that made reports during 2014, which is consistent with previous years.

Number of SHOT reports by UK country

Table 2.1: Total number of reports to SHOT by UK country 2011-2014

	2011		2012		2013		2014	
	Number	%	Number	%	Number	%	Number	%
England	2749*	80.0	2860*	80.7	2975	83.4	3119	85.0
Northern Ireland	150	4.4	156	4.4	129	3.6	98	2.7
Scotland	352	10.2	326	9.2	285	8.0	278	7.6
Wales	184	5.4	203	5.7	179	5.0	173	4.7
United Kingdom	**3435**	100	**3545**	100	**3568**	100	**3668**	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 2014

	Red cells	Platelets	FFP	SD-FFP	MB-FFP	Cryo	Totals
NHS Blood & Transplant	1,668,805	274,623	214,732	70,557	9,329	39,720	2,277,766
Northern Ireland Blood Transfusion Service	51,886	8,855	4,318	460	386	1,188	67,093
Scottish National Blood Transfusion Service	172,308	25,960	18,915	3,280	861	2,006	223,330
Welsh Blood Service	73,867	9,101	9,501	2,588	0	242	95,299
Totals	**1,966,866**	**318,539**	**247,466**	**76,885**	**10,576**	**43,156**	**2,663,488**

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 by UK Blood Service 2011-2014

	2011	2012	2013	2014
NHS Blood & Transplant	10.9	11.7	12.7	13.7
Northern Ireland Blood Transfusion Service	21.1	21.3	18.7	14.6
Scottish National Blood Transfusion Service	14.3	13.2	11.8	12.4
Welsh Blood Service	16.4	18.4	17.2	18.2
Total	**11.6**	**12.3**	**12.9**	**13.8**

CS=cell salvage, UCT=unclassifiable complications of transfusion

Cases included in the 2014 Annual SHOT Report n=3017

Cases analysed in the 2014 report include some which were reported in 2013 but not completed until 2014. Similarly some of the 3668 cases reported to SHOT in 2014 are currently incomplete and will roll over to the 2015 report. The flow chart below shows the breakdown of the reports made to the SHOT database during 2014.

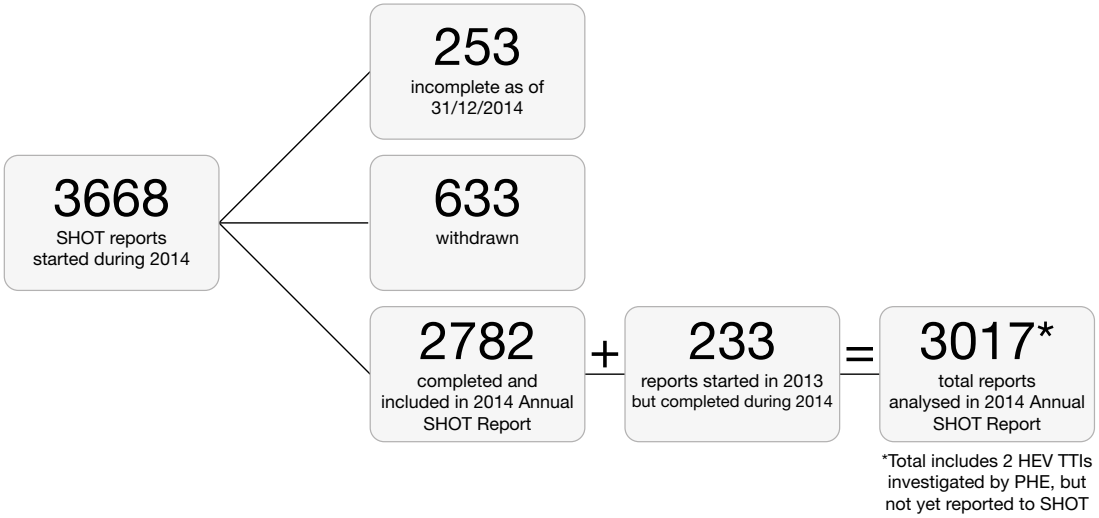


Figure 2.2: Breakdown of reports to SHOT in 2014

The total number of reports analysed and included in the 2014 Annual SHOT Report is 3017. This is an increase of 9.7% from 2751 reports analysed in the 2013 Annual SHOT Report. The number of reports excluding 'near miss' and 'right blood right patient' is 1681 (1571 in 2013).

The increase in analysed reports for 2014 is not wholly due to an increase in reporting levels, as the overall number of reports was only slightly increased by 2.8% from 3568 in 2013 to 3668 in 2014. The increase in numbers is more due to the fact that fewer reports were incomplete at the end of the year, and fewer were withdrawn. For example, in 2013 there were 303 incomplete and 670 withdrawn cases. There was also an increase in the number of reports being completed and included from the previous year.

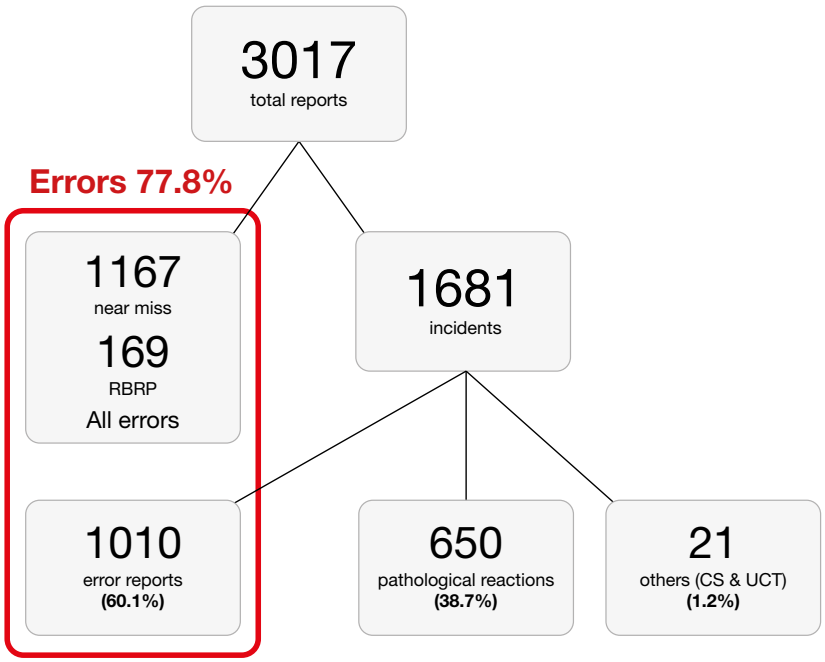


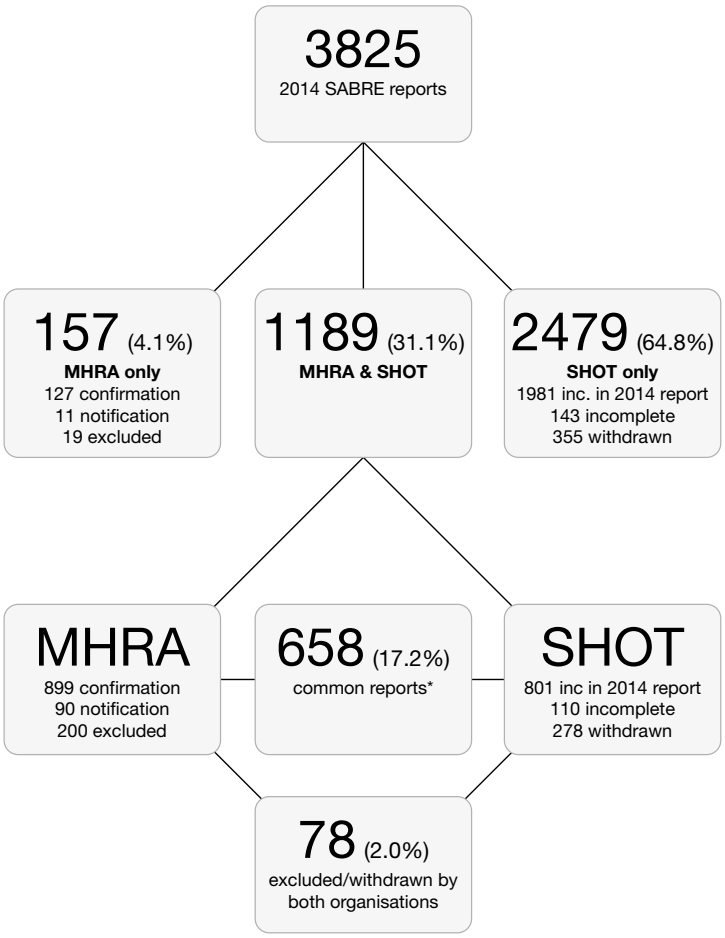
Figure 2.3: Categorisation of reports analysed in 2014

**CS=cell salvage; UCT=unclassifiable complications of transfusion*

Data reconciliation between the MHRA and SHOT

For the second year in succession analysis has been carried out for all reports made to SHOT and the MHRA. Figure 2.4 shows the fate of all reports made via the SABRE system during the calendar year 2014. These numbers have been produced from the total cases reported to the MHRA as serious adverse events (SAE) or serious adverse reactions (SAR), combined with the total cases shared with the SHOT database or reported via SABRE as 'SHOT only'.

Figure 2.4: Fate of all reports made to SABRE in 2014 (all SHOT reports are made via the SABRE entry portal where the reporters can direct their report to SHOT only as required)



**Common reports are those completed and included in the SHOT chapters within this 2014 Annual SHOT Report and Chapter 6 Medicines and Healthcare products Regulatory Agency (MHRA) Report on Blood Safety and Quality Regulation in 2014*

The pattern is similar to 2013, with 658/3825 (17.2%) reports being confirmed as reportable by both organisations (607/3692 16.4% in 2013). Further analysis of these common reports will be undertaken to identify the specific areas of duplication between the two organisations.

Reference

Poles D, Watt A, et al. (2014) **Haemovigilance reporting in the UK 2013 - collaboration to reduce confusion.** Transfus Med Suppl.2 PO46, page 50

SHOT Updates and Developments 3

Author: Paula Bolton-Maggs

Joint haemovigilance reporting

Over the past 12 months we have made significant progress in planning for a single haemovigilance system. Careful reconciliation of data reported to the Medicines and Healthcare products Regulatory Agency (MHRA) and to SHOT demonstrated that many serious adverse reactions (SAR) are not being reported to the MHRA.

We examined reports made in 2013 and compared those reported to SHOT with those reported to the MHRA. We were surprised to find that there was common reporting to both systems only in 607 cases (16.4%). Further analysis of 192 reaction reports made only to SHOT demonstrated that 98 of these (51%) should have been reported also to the MHRA (74 acute transfusion reactions (ATR), 4 haemolytic transfusion reactions (HTR), and 20 cases of transfusion-associated circulatory overload (TACO)). A further 30 cases possibly should also have been reported. In some of these, the severity of the reaction was not captured in the initial brief description field, but later in the more detailed SHOT fields (Poles et al. 2014). The MHRA haemovigilance team are experienced in handling quality issues from laboratories but do not have any clinical background for further analysis of clinical events. We have therefore agreed that all SAR reports will be analysed and categorised by the SHOT expert group who will decide which require reporting to the European Union (EU) via the MHRA. To facilitate this all reports will be visible to both MHRA and SHOT. If there are queries from the MHRA team relating to any of these, they will be relayed through the SHOT office to avoid several different people contacting the reporters for further information.

Definition of Serious Adverse Reactions

For the purposes of the Blood Safety and Quality Regulations (BSQR) as derived from EU legislation, SAR are defined as any reactions in patients that are '**life-threatening, disabling or incapacitating, or which result in or prolong hospitalisation or morbidity**'. This definition has been added to the clinical reaction chapters in this report to remind reporters that it is their legal duty to report these. The reportable categories for EU and SHOT are compared in Table 3.1.

Table 3.1: MHRA categories for EU reporting of SAR compared with SHOT categories

MHRA category for reporting SARs to EU	Equivalent SHOT category (where applicable)
Immunological haemolysis due to ABO incompatibility	Incorrect blood component transfused resulting in ABO incompatibility (but not all EU reportable, only those with evidence of haemolysis)
Immunological haemolysis due to other alloantibody	Haemolytic transfusion reactions
Transfusion related acute lung injury (TRALI)	TRALI
Non-immunological haemolysis	No equivalent SHOT reaction category
Transfusion-transmitted bacterial infection	When proven, reportable as transfusion-transmitted infections
Transfusion-transmitted viral infection (HBV)	
Transfusion-transmitted viral infection (HCV)	
Transfusion-transmitted viral infection (HIV-1/2)	
Transfusion-transmitted viral infection, other (specify)	
Transfusion-transmitted parasitical infection (Malaria)	
Transfusion-transmitted parasitical infection, other (specify)	
Post-transfusion purpura (PTP)	PTP
Graft-versus host disease (GvHD)	Transfusion-associated GvHD
Anaphylaxis/hypersensitivity	ATR (allergic/anaphylactic, hypotensive and severe febrile)
Febrile non-haemolytic reactions (FNHTR)	
Other serious reactions including TACO, TAD	TACO and transfusion-associated dyspnoea (TAD)
Other serious reactions - uncategorised unintended responses	Unclassifiable complications of transfusion (severe)
Not reportable to EU	Cell salvage reactions

It is important to attribute a level of causation (imputability) to each event, i.e. to what extent can the reaction be attributed to the transfusion. The definitions are shown in Table 3.2, and we have amended the question related to imputability to be a mandatory field for SHOT reporting in the SHOT database (Dendrite).

Although these definitions appear clear cut, in many clinical situations it can be difficult to decide to what extent the transfusion was responsible, and this is well-illustrated in patients who develop pulmonary complications. Some examples are given in Chapter 19, Pulmonary Complications. It can be difficult to classify some cases when the data are insufficient. We urge reporters to obtain as much detail as possible for the clinical reactions so that they can be accurately attributed to the correct category and appropriate level of imputability.

Table 3.2: Definitions of imputability

Classification	Category	Definition
Not applicable	Not assessable	Insufficient information
0	Excluded	Conclusive evidence beyond reasonable doubt for attributing the adverse reaction to other causes
0	Unlikely	Evidence in favour of alternative causes
1	Possible	Evidence indeterminate for either blood/blood component or alternative cause
2	Likely	Evidence clearly in favour of blood/blood component as cause
3	Certain	Conclusive evidence beyond reasonable doubt for attributing the adverse reaction to the blood/blood component

Definition of 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.

It is more difficult to match events reported to SHOT with the SAE as defined for the EU, but Table 3.3 demonstrates how this might be done.

MHRA	SHOT also	SHOT only
Blood Centre and all hospital laboratory testing and issue errors	Laboratory errors (all)	
Wrong component collected	Incorrect blood component transfused (IBCT) - WCT due to collection errors	Wrong component transfused (WCT) due to failure of bedside checks
Wrong or inappropriate component issued	Specific requirements not met (SRNM) laboratory errors	SRNM due to request or prescription errors and failures to inform laboratory where there are no laboratory errors
Breach of the 30-minute rule where blood is returned to the supply chain after 30 minutes	HSE – cold chain errors	HSE long transfusion time for single units or where units are set up more than 30 minutes after collection from cold storage
RBRP laboratory errors	RBRP laboratory errors	RBRP clinical errors
Some near miss (NM) errors would fit the EU definition		NM reporting
None of these		Anti-D Ig errors Anti-D sensitisation Avoidable, delayed or undertransfusion (ADU) Cell salvage

Table 3.3: Comparison of SAEs that might be reported to MHRA and SHOT or both

HSE=handling and storage errors, RBRP=right blood right patient

Progress with key recommendations made in the Annual SHOT Report for incidents reported in 2013

Process redesign: Annual SHOT data consistently demonstrate errors to be the largest cause of adverse transfusion incidents. In line with human factors and ergonomics research it may be better to redesign the transfusion process by process mapping and audit at local and national level, to design out the medical errors.

Progress: We have held discussions with the National Clinical Audit (England) team and with the England National Blood Transfusion Committee chair. Audit of the transfusion process in a small number of large hospitals is planned as a pilot, to see why and how people make workarounds and take short cuts.

A project has been undertaken in Scotland: Right First Time

Sandra Gray and Sam Rawlinson provided the following report:

A collaborative study, led by the University of Nottingham, the Scottish National Blood Transfusion Service and NHS Education Scotland was undertaken on behalf of NHS Scotland to understand why variability exists in patient identification and labelling of blood samples. The study adopted a qualitative approach including observation of practice, practitioner interviews, a review of incident data and a literature review. The observations and interviews took place across 4 Scottish hospitals. The aim of this study is to understand 'work as done' rather than 'perceived to be done' and to identify factors contributing to the variability of work practices in the context of: clinical departments, working environments and organisational goals. The data were used to inform the Functional Resonance Analysis Method (Hollnagel 2012); this method was used to model the interactions between the functions relevant to blood sampling and the potential variability in performance which assists in focusing safety management activities to dampen down unwanted variability. The findings will be available in 2015.

All ABO-incompatible red cell transfusions to be included as 'never events': ABO-incompatible red cell transfusions may be fatal and are absolutely preventable. The two thirds that do not result in harm should be included as reportable 'never events'.

Outcome: NHS England, patient safety domain has published a revised 'Never Events' list (March 27th 2015). This includes 'transfusion of ABO-incompatible blood components or organs' but 'excludes where ABO-incompatible blood components are deliberately transfused with appropriate management' and 'excluded are scenarios in which clinically appropriate ABO-incompatible solid organs are transplanted deliberately'.
http://www.england.nhs.uk/wp-content/uploads/2015/03/never-evnts-list-15-16.pdf

Management of blood and blood component transfusion to be included as a specific standard by the Care Quality Commission. This should include the same subset of standards as currently apply to medicines (Outcome 9).

Outcome: Discussions are in progress with the Care Quality Commission

Discussions have taken place between CQC and SHOT as to how SHOT data could be used by CQC to help understand transfusion practices. Reported benchmarking data will be shared with CQC to examine how this information can support inspections. CQC fully understand that rates of reporting vary considerably and for different reasons but guidance will be provided by SHOT to ensure these data are interpreted correctly and used appropriately during inspection to discover how Trusts manage risks and learn from errors. These questions are already in place for other areas.

Don't give two without review: Transfusion-associated circulatory overload is a significant hazard particularly when elderly or other patients at risk (renal impairment, cardiac disease, obstetric haemorrhage, gastro-intestinal haemorrhage) receive several units of blood without review and a check on the Hb level. This recommendation reminds staff that patients having transfusion should be regularly reviewed to ensure each unit is indicated. SHOT has noted several instances of major morbidity and death from TACO where individuals with gastrointestinal (GI) haemorrhage have been overtransfused without appropriate regular reassessment. Patient Blood Management endorses the principle that transfusion should be individually determined to ensure that it is in the patient's best interest.

Outcome: Preliminary audit (see below) of hospitals shows that this is considered an important recommendation to action, but is difficult.

Advice for patients: Day case or outpatient transfusions: with the increased emphasis on day case and community care, patients receiving transfusions need to be given printed advice, be advised to report any symptoms or complications and provided with a 24-hour contact number.

Action: This advice has been previously recommended in British Committee for Standards in Haematology (BCSH) guideline on the administration of blood components (BCSH Harris et al. 2009).

In addition to these main recommendations, there were several others in the individual chapters. We realise that implementation of numerous recommendations may be difficult. Many recommendations reiterate those made in previous years, or are already covered by BCSH guidelines. This year we have minimised new recommendations and have directed readers to relevant guidelines. As a result there are only two main recommendations. The first is a revision of the previous guidance about transfusion at night. This has been circulated widely and agreed by Colleges and other professional groups prior to publication. The second recommendation relates to TRALI. These are covered in Chapter 5 Key Messages and Recommendations.

We have undertaken a pilot audit of a small number of hospitals to find out which recommendations they have tried to follow and their progress with these. This will be used as the basis for a wider and more detailed review in 2015. We are collating all the SHOT recommendations made over the past 18 years to see how many have been repeated and to use as the standards for the audit. The results of the pilot project are given below.

Audit of the implementation of SHOT recommendations

We designed and distributed a survey to 21 volunteer participants representing different hospitals/Health Boards across England, Wales and Scotland to see what successes or difficulties/challenges they experience when attempting to implement SHOT recommendations published between 2011 and 2013.

This pilot survey of 9 questions was sent initially to 13 reporters spread across England, Wales and Scotland (December 2014) and then to additional hospitals in the area represented by the East Coast regional transfusion committee (February 2015).

Results:

Gap analysis:

- 8/21 hospitals perform a gap analysis against all of the SHOT recommendations
- 6/21 do not perform a gap analysis
- The remaining hospitals only perform them for some of the recommendations (4/21) or the key recommendations (2/21), in 1 reply the respondent did not know

The recommendations are discussed at both the hospital transfusion committee or hospital transfusion team meeting or equivalent (13/21), if not one or the other, Figure 3.1.

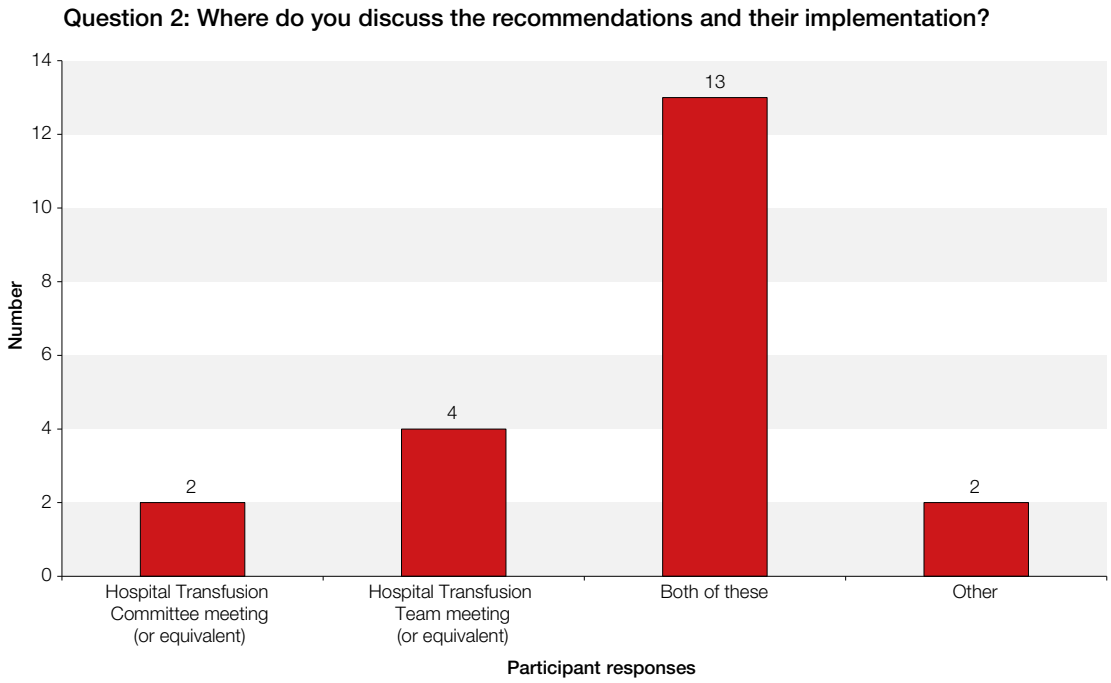
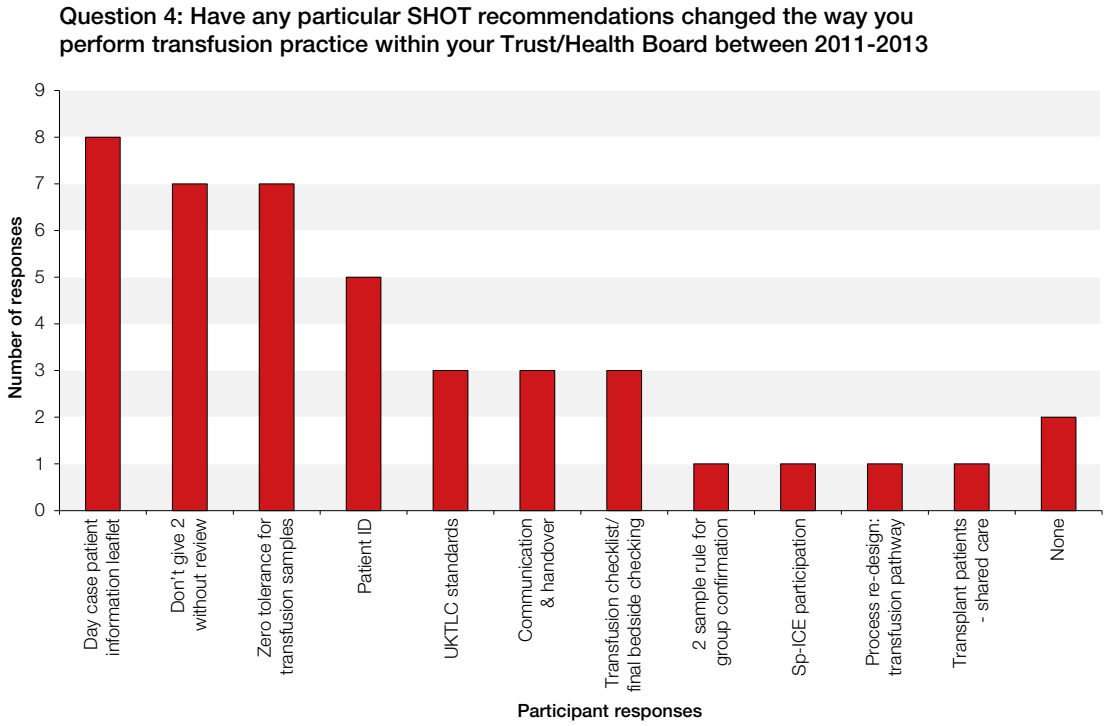


Figure 3.1: Where SHOT recommendations and their implementation are discussed

Reporters were able to specify a maximum of 3 recommendations that have positively changed the way their hospitals/Health Boards practice transfusion between 2011-2013. The 3 most common recommendations were:

- Provision of a patient information leaflet for day case transfusions
- Don't give 2 without review for the management of transfusion-associated circulatory overload (TACO)
- Zero tolerance approach for labelling of transfusion samples

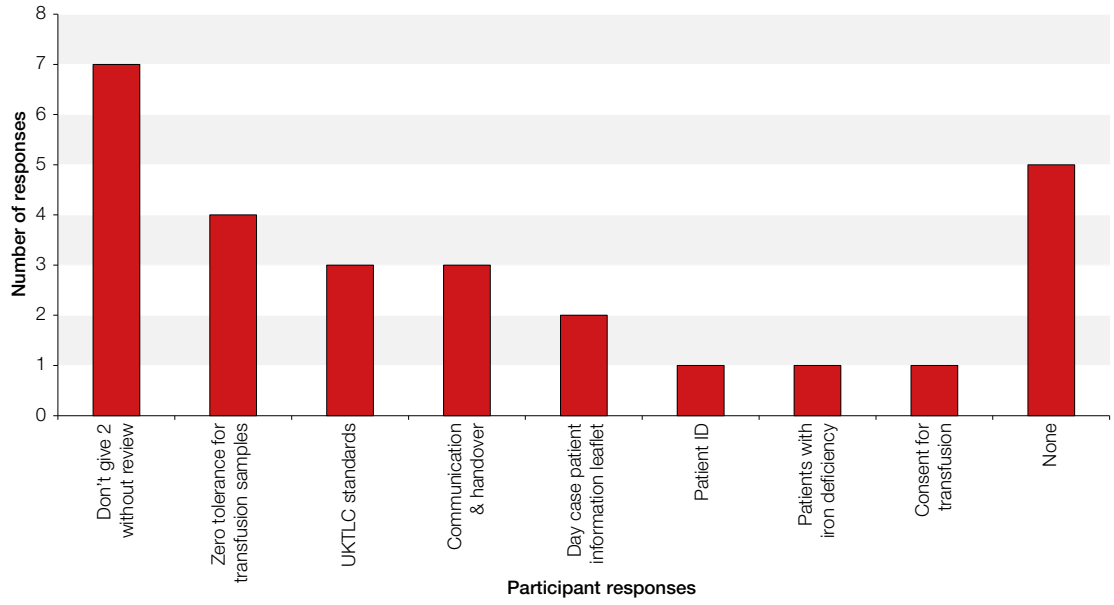
Figure 3.2: SHOT recommendations that have changed the way you perform transfusion practice within your hospital 2011-2013



Reporters commented that the following recommendations had been particularly difficult to implement:

- Don't give 2 without review: clinical teams were reluctant to comply, it is very difficult to change the mind set of members of staff who are used to issuing 2 units as standard practice
- Zero tolerance approach for transfusion samples
- Communication and handover: although reporters understand the importance, this relies on other hospitals and departments taking ownership, particularly in relation to sharing information about transplants

Figure 3.3: SHOT recommendations that are particularly difficult to implement within your hospital 2011-2013



SHOT promotes near miss incident reporting, and encouragingly all 21 reporters confirmed that their hospitals do report these to SHOT.

Comments and conclusions:

This pilot survey has demonstrated areas that are of concern to reporters. It takes time for hospitals to implement recommendations. Changing practice is often a slow process and multi-faceted, and may be handicapped perhaps by local staffing problems and financial constraints with consequent lack of resources for education and retraining.

Nevertheless reporters consider the SHOT recommendations to be important especially when used in conjunction with the BCSH guidelines. The educational output from SHOT is valued and reporters look forward to the publication of the SHOT Summary and the Laboratory and Clinical lessons documents. These are incorporated into training packs and presentations. These are excellent teaching resources and can be downloaded from the website, www.shotuk.org under the Resources section.

We plan to do a wider audit of all reporting hospitals in the next few months to better understand how SHOT recommendations are actioned and what problems are experienced in this.

Reporting reminders

Please continue to report cases of hyperhaemolysis and transfusion-associated necrotising enterocolitis (NEC)

Hyperhaemolysis (HH) is a condition of excessive red cell destruction where both transfused and autologous cells are haemolysed and is most commonly reported in sickle cell disease (see Chapter 15, Haemolytic Transfusion Reactions (HTR), and Chapter 21, Update on Transfusion Complications in Patients with Haemoglobin Disorders). An advisory panel is available for urgent consultation via the National Health Service Blood and Transplant (NHSBT) if clinicians require assistance in management of such cases. Clinicians should contact their red cell immunohaematology (RCI) consultant in normal hours, or the Blood Service consultant on call as soon as possible after HH is suspected. Details will be recorded on a proforma but clinicians should also make their own report to SHOT. These cases should be reported as HTR. The advisory panel includes Nay Win, Paul Telfer, Clare Milkins and Shubha Allard. Clinicans will be asked to report outcome at annual intervals to learn what measures are taken with further transfusions. Haematologists in the devolved countries are welcome to participate in this survey.

Transfusion-associated necrotising enterocolitis (TANEC) occurs in premature neonates. Necrotising enterocolitis is a serious disorder which in some cases appears to be triggered by red cell transfusion. Two cases were reported to SHOT in 2011 and we will continue to accept these. Please report them under the 'Uncategorised Complications of Transfusion' category. Published data suggest that 27-38% of NEC cases are transfusion-related. These are defined as those occurring within 48 hours of red cell transfusion (Gephart 2012).

Plans for donor adverse event reporting in the UK

Update contributed by Sue Barnes, Chair of the Standing Advisory Committee Care and Selection of Donors, JPAC

A donor adverse event (DAE) is a reaction affecting a donor linked to planned or actual donation, occurring shortly before, during or after donation. These reactions have no direct implication for the blood component or patient recipient.

The blood supply depends entirely on the daily commitment of volunteers, who ostensibly gain little personal benefit from blood donation but are exposed to potential risk of discomfort, complications and, in rare cases, injury resulting from the collection procedure. About 2-6% of all presenting donors experience an adverse event, most of which are classified as light, mild or minor reactions that resolve promptly but are still unpleasant for the donor, serious adverse events occur infrequently.

Donor adverse events fall into two main categories: events related to the venepuncture itself producing local symptoms, and generalised vasovagal events. Events related to apheresis, allergies and other

events are much less common. In 2014 the International Society of Blood Transfusion (ISBT)/International Haemovigilance Network (IHN) Haemovigilance working party suggested a new, more comprehensive, standardised international categorisation for these events (ISBT/IHN 2014). Having reviewed these proposals the 4 UK Blood Services have agreed to amend their recording processes for DAEs and to start reporting to SHOT the numbers and rates of occurrence for all DAEs on an annual basis from 2016. The denominator used would be all donations (that proceed to phlebotomy). The agreed categories are given in Table 3.5. This will allow the Services to benchmark their performance in the area of DAEs against each other within the UK, and as these definitions have been endorsed by several groups (ISBT, the American Association of Blood Banks (AABB) and the European Blood Alliance (EBA)), use of these should facilitate wider international comparison and sharing of good practice.

The ISBT/IHN working party went on to suggest grading these events as minor, moderate or severe and defined severe events as a DAE event definitely, probably or possibly attributable to donation that resulted in:

- Hospitalisation
- Intervention to prevent permanent damage or impairment of a body function or to prevent death
- Symptoms causing significant disability or incapacity persisting for more than a year after the donation
- Death

To facilitate this the 4 UK Blood Services have defined 10 categories of serious DAEs which we will report to SHOT annually and for which we will determine imputability, Table 3.4.

Table 3.4: Serious donor adverse events

Serious donor adverse events
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 donors (CD))
8) Haemolysis (CD)
9) Air embolism (CD)
10) Other event linked to donation resulting in hospitalisation, intervention or disability/incapacity for more than one year after donation, not included above

Table 3.5: Donor adverse event categories

Donor adverse event categories			
Local symptoms	Blood outside vessels		Haematoma
			Arterial puncture
			Delayed bleeding
	Pain syndromes		Nerve irritation (by haematoma)
			Nerve injury (by needle)
			Tendon injury
			Other painful arm
	Localised Inflammation		Local infection/cellulitis
			Thrombophlebitis
	Other major blood vessel injury		Deep vein thrombosis
			Arteriovenous fistula
			Compartment syndrome
			Brachial artery pseudoaneurysm
	Others		Thrombophlebitis
			Allergy (local)
Generalised symptoms	Vasovagal reaction	On collection site	Mild - subjective symptoms no LOC*
			Moderate - objective symptoms with LOC <60 seconds
			Severe - objective symptoms with LOC >60 seconds or with convulsion or incontinence but no injury
			Vasovagal reaction leading to injury
		Delayed (after leaving site)	Mild - subjective symptoms no LOC
			Moderate - objective symptoms with LOC <60 seconds
			Severe - objective symptoms with LOC >60 seconds or with convulsion or incontinence but no injury
			Vasovagal reaction leading to injury
Related to apheresis			Citrate reaction
			Haemolysis
			Air embolism
			Infiltration
Allergic reactions and other complications	Allergic reactions		Local allergic reaction
			Generalised (anaphylactic) reaction
	Major cardiovascular event		Myocardial infarction (MI)
			Cardiac arrest
			Transient ischaemic attack
			Cerebrovascular accident
			Death <24 hours
			Acute cardiac symptoms (other than MI or cardiac arrest)

** LOC loss of consciousness*

Working Expert Group (WEG) – departures and arrivals

We are extremely grateful to our WEG who complete the analysis and writing around their already busy jobs. This year several individuals who have supported SHOT for many years, some since the beginning, are stepping down and they will be greatly missed. We record our grateful thanks to them for their wisdom, humour, dedication and hard work and wish them well in the future. These individuals have analysed and written on the following topics:

- Hannah Cohen - Steering Group chair until 2012 – transfusion-associated circulatory overoad (TACO) and transfusion-associated dyspnoea (TAD)
- Catherine Chapman - transfusion-related acute lung injury (TRALI) and post-transfusion purpura (PTP) (successor Tom Latham)
- Hazel Tinegate - acute transfusion reactions (ATR) (successor Janet Birchall)
- Sandra Gray - handling and storage errors (HSE), and right blood right patient (RBRP) reports
- Tony Davies – the lead for anti-D events and also a highly valued member of the SHOT team

Following a wide invitation for expressions of interest for new members of the WEG, applicants were interviewed and the following have joined us. Rather than each member having a single area of focus, teams of two or three are likely to work together:

- Diane Sydney replaces Sandra Gray with responsibility for the devolved countries as well as the topics RBRP and HSE
- Lilian Parry will be focusing mainly on the anti-D errors in association with Jane Keidan and Tony Davies (until he retires in December 2015)
- Sharran Grey will be sharing responsibility for TACO and TAD with Dafydd Thomas and Paula Bolton-Maggs

References

BCSH Harris A M, Atterbury CLJ et al. (2009) **BCSH Guidelines on the administration of blood components** http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf [Accessed 30/03/2015]

Gephart SM (2012) **Transfusion-associated necrotizing enterocolitis (TANEC): evidence and uncertainty**. Adv Neonatal Care 12(4), 232-236.

Hollnagel E (2012) **FRAM: the Functional Resonance Analysis Method**. Surrey, Ashgate.

ISBT/IHN (2014) **Revised Standard 2014 Surveillance complications blood donation** http://www.isbtweb.org/working-parties/haemovigilance/

Poles D, Watt A, et al. (2014) **Haemovigilance reporting in the UK 2013 - collaboration to reduce confusion**. Transfus Med Suppl.2 PO46, page 50

Summary of Main Findings and Cumulative Results

4

Authors: Paula Bolton-Maggs and Debbi Poles

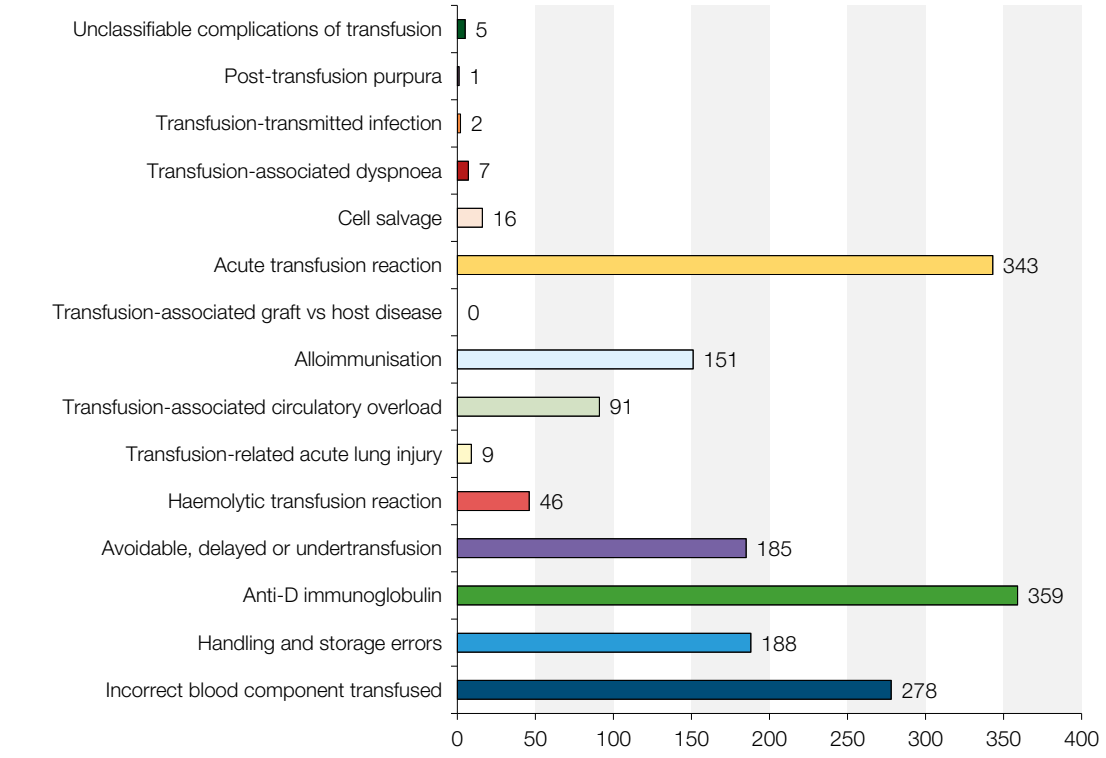


Figure 4.1: Cases reviewed in 2014 n=1681

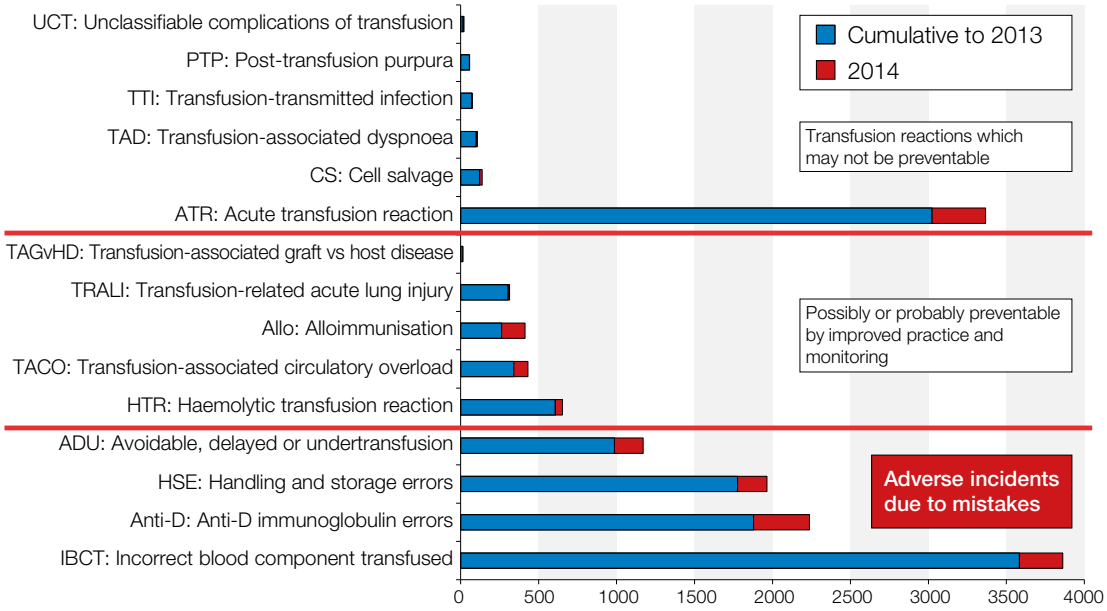


Figure 4.2: Cumulative data for SHOT categories 1996/7-2014 n=14822

Deaths n=15 (22 in 2013)

This number includes deaths definitely, probably and possibly related to the transfusion. Transfusions with pulmonary complications contributed most to both deaths and major morbidity. There was one death related to a haemolytic transfusion reaction.

Major morbidity n=169 (143 in 2013)

Most major morbidity was caused by acute transfusion reactions and pulmonary complications.

Review of mortality and morbidity data

For further information about these cases please see the subject chapters.

Definitions:

Major morbidity is defined as:

- Intensive care or high dependency admission and/or ventilation
- Dialysis and/or renal impairment
- Major haemorrhage from transfusion-induced coagulopathy
- Evidence of acute intravascular haemolysis e.g. haemoglobinaemia or severe haemoglobinuria
- Life-threatening acute reaction requiring immediate medical intervention
- Persistent viral infection
- Acute symptomatic confirmed infection
- Sensitisation to D or K in a woman of childbearing potential
- Reaction resulting in a low or high haemoglobin (Hb) level of a degree sufficient to cause risk to life unless there is immediate medical intervention

Potential for major morbidity: potential risk of D or K sensitisation in a woman of childbearing potential

Table 4.1: Mortality and morbidity data by reporting category

	Death definitely related	Death probably/likely related	Death possibly related	Major morbidity	Potential for major morbidity
ADU	-	-	3	4	-
ANTI-D	-	-	-	4	270
ATR	-	-	-	104	-
HTR	1	-	-	5	-
IBCT	-	-	-	4	7
UCT	-	-	-	2	-
TACO	1	3	2	36	-
TAD	-	1	2	2	-
TRALI	-	1	1	7	-
TTI	-	-	-	1	-
Total	**2**	**5**	**8**	**169**	**277**

TRALI is a serious complication; 2/9 patients died and 7/9 required ventilation. It is notable that TACO is associated with a high risk of death or major morbidity, together 42/91 (46.2%). Acute transfusion reactions were also associated with major morbidity in 104/343 (30.3%).

Risk of major morbidity and mortality per 1,000,000 components issued in 2014	
Total morbidity	63.5
Total mortality	5.6

	Mortality	Major morbidity	Total cases
All errors	1.1	4.5	379.2
Acute transfusion reactions	0.0	39.0	128.8
Haemolytic transfusion reactions	0.4	1.9	17.3
Transfusion-related acute lung injury	0.8	2.6	3.4
Transfusion-associated circulatory overload	2.3	13.5	34.2
Transfusion-associated dyspnoea	1.1	0.8	2.6
Transfusion-associated graft versus host disease	0.0	0.0	0.0
Post-transfusion purpura	0.0	0.0	0.4
Cell salvage	0.0	0.0	6.0
Transfusion-transmitted infection	0.0	0.4	0.8
Unclassifiable complications of transfusion	0.0	0.8	1.9
Paediatric cases	0.0	9.0	45.8

Table 4.2: Relative risks of major morbidity or death (imputability 1-3) based on overall data and by incident type

ABO-incompatible red cell transfusions n=10 (no deaths, major morbidity n=1)

All these events were due to clinical errors and are described in Chapter 9 Incorrect Blood Component Transfused (IBCT). Only 4 of these showed evidence of haemolysis (which is the definition for reporting to the European Union (EU)); one patient suffered renal failure (Case 1, Chapter 9) and would have been the only one reportable in 2014 as a 'Never Event' but now, with the change in definition, all would be 'Never Events'.

Total number of errors n=2346

Categories of reports where no harm was done n=1336

Near miss n=1167 (wrong blood in tube n=686). Further details can be found in Chapter 7 Near Miss Reporting (NM).

Right blood right patient n=169 (Chapter 23 Right Blood Right Patient (RBRP) in the 2014 Annual SHOT Report: Web Edition). One of these cases included 273 instances related to misuse of the Haemonetics BloodTrack system (see Chapter 12 Summary of Errors Related to Information Technology).

Number of incidents caused by other errors n=1010

- HSE n=188 (Chapter 24 Handling and Storage Errors (HSE) in the 2014 Annual SHOT Report: Web Edition). There were 37 cases of excessive time to transfuse but none were associated with clinical adverse events
- ADU n=185 (Chapter 10 Avoidable Delayed or Undertransfusion (ADU))
- Anti-D errors n=359 (Chapter 25 Anti-D Ig incidents in the 2014 Annual SHOT Report: Web Edition)
- IBCT wrong component transfused n=76 and specific requirements not met n=202 (Chapter 9 Incorrect Blood Component Transfused (IBCT))

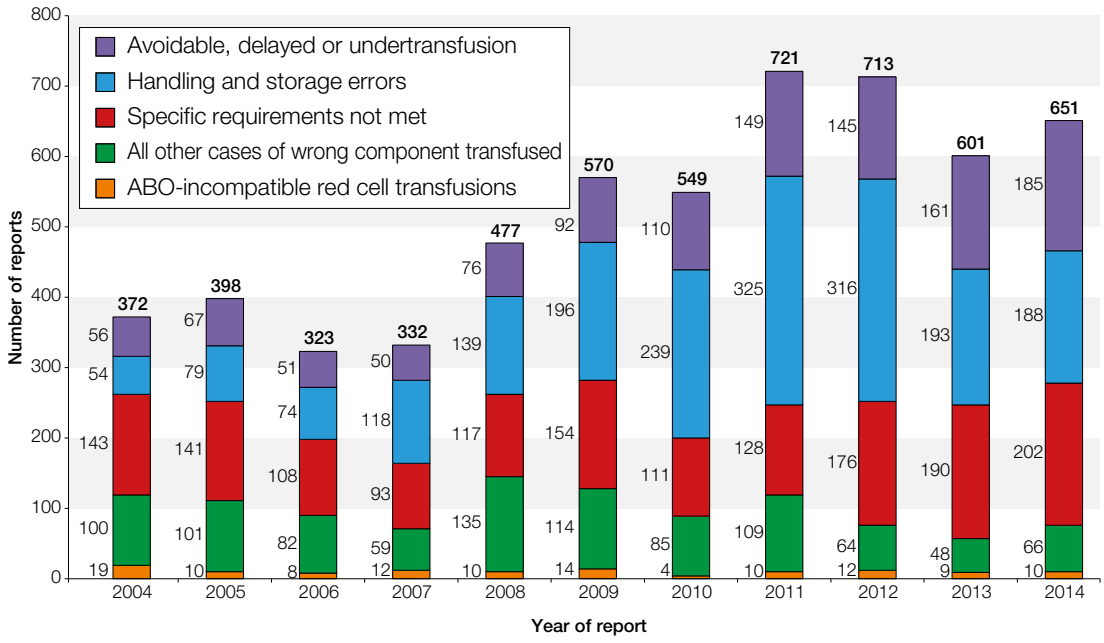
The most common specific requirement not met is **failure to provide irradiated cellular components** to those at risk. This was noted in 116 reports in 2014, and was caused by clinical failures in the majority (102/116; 87.9%).

Transfusion-associated graft versus host disease (TA-GvHD) is rare but uniformly fatal and preventable by irradiation of cellular components. Leucodepletion (LD), introduced during 1999, provides some degree of protection but must not be relied upon since not all units are tested to ensure adequate reduction in leucocytes and there are some failures. In addition, there is no scientific evidence that for the most immunosuppressed, LD is adequate, and indeed animal evidence that LD is not adequate.

Cumulative SHOT data show that there have been 1114 reported instances where patients should have received irradiated components but did not since leucodepletion was introduced. Fortunately there have been no cases of TA-GvHD in these patients.

A systematic review of TA-GvHD reports identified 348 cases (Kopolovic et al. 2015). Although 170 patients met criteria for irradiation this had been missed in 166 (97.6%). In addition, only 23 were leucodepleted (10 at the bedside, 2 pre-storage and 11 not specified). TA-GvHD was always rare, even in the days before irradiation, and the number of irradiation omissions is still too small to provide reassurance, therefore irradiation continues to be indicated for at-risk groups for the forseeable future and it is important that clinicians work to ensure that this guidance is met.

Figure 4.3: Cumulative numbers for blood component error-related reports (excluding anti-D Ig)



As reported in previous years, errors are made by staff who have been trained and competency assessed. In addition, where wrong components are transfused, it appears to make no difference whether there is one person or two checking at the bedside; errors are reported with both. We do not know denominator figures for this (i.e. how many hospitals use one or two).

Transfusion reactions are uncommon in comparison to the rate of error which is responsible for 77.8% of all reports to SHOT and 68.8% of all reports to the MHRA. As noted last year, many transfusion episodes exhibit multiple errors in the process, and these are described fully in Chapter 9 Incorrect Blood Component Transfused (IBCT). The transfusion process is multidisciplinary and training should ensure that each participant is aware how important their individual role is as part of the whole process to ensure patient safety.

Reference

Kopolovic I, Ostro J et al. (2015) **A systematic review of transfusion-associated graft versus host disease**. Blood pre-published online April 30; DOI 10.1182/blood-2015-01-620872

Key Messages and Recommendations

5

Authors: Paula Bolton-Maggs and Dafydd Thomas

Findings for 2014 are consistent with previous years: the majority of reports to both SHOT and the Medicines and Healthcare products Regulatory Agency (MHRA) relate to errors in the transfusion process, frequently multiple (Chapter 9 Incorrect Blood Component Transfused (IBCT)).

Incident investigation should be appropriate

Two years ago, in the Annual SHOT Report 2012, (Bolton-Maggs et al. 2013) we included a chapter about investigating transfusion incidents using root cause analysis but this needs to be revisited. We are concerned that investigations are not always performed appropriately. It is important that the investigation is appropriate to the severity of the incident, and also that the root cause is fully understood. To identify that an error occurred because a staff member was distracted, or overstretched etc. is not sufficient. We need to identify why this happened and what needs to be done to correct it.

Good root cause analyses can be shared on the SHOT website: please see www.shotuk.org under the Resources section where there are examples.

Hierarchy of incident investigation based on risk-assessment

Joan Jones and Tony Davies

Incident investigations are one of the areas which can consume significant time for laboratory staff and transfusion practitioners. This may not always be warranted.

The intention of the European Union (EU) Blood Safety and Quality Directive is not that every single event or reaction is reported, but only 'serious' ones, as defined in the legislation. Defining 'serious' in the context of a report might not always be easy. With each incident try to consider whether a patient or the safety and quality of the blood component was, or might have been put at risk. Consider also, whether the incident resulted in hospitalisation or morbidity or whether hospitalisation or morbidity was prolonged.

Another consideration is whether the quality management system (QMS) detected the error before it left the laboratory. If this is the case it may be that you only report it into your local incident system and consider what local actions need to be addressed.

For example, if a compatibility label is transposed with another from the same patient, it may be appropriate to see this as a one-off event and therefore reporting it to the local system and then monitoring the process for a repeat error may be all that is required. If the error is repeated then it is at this point that you may feel that this is the trigger to report it to Serious Adverse Blood Reactions and Events (SABRE) and SHOT, reporting both events as one report. Alternatively if compatibility labels are transposed from one patient to another, this is immediately reportable as it poses a greater risk of transfusing the wrong unit to the wrong patient.

Tracking and trending the types of incidents and/or the staff involved can provide information that is invaluable in determining appropriate corrective and preventative actions (CAPA) that are meaningful to your organisation.

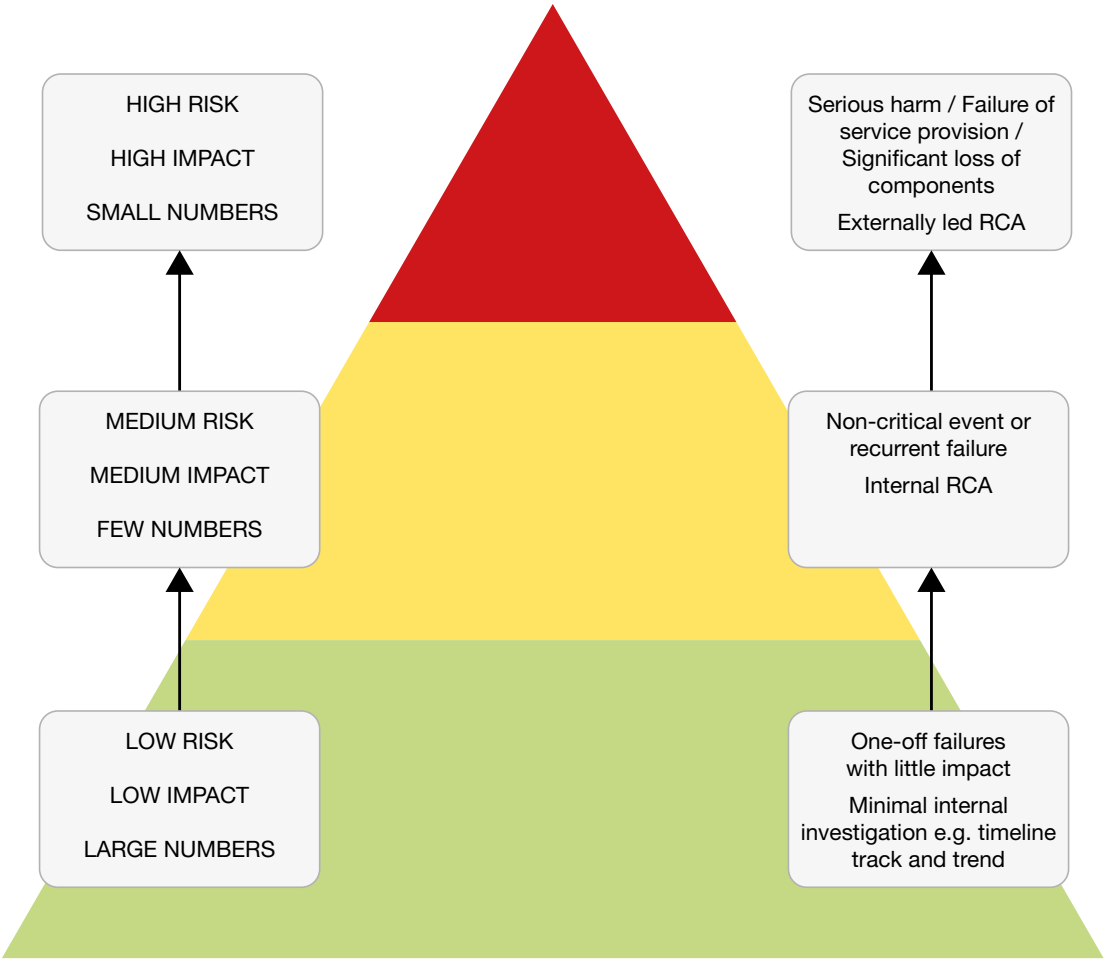


Figure 5.1: The hierarchy of investigation. Few incidents are of high severity warranting an external investigation

Recommendations are not rules, and must be considered in context, particularly the clinical needs of the patient

We are aware of instances where SHOT recommendations have inappropriately been taken out of context and used as rules. Transfusion at night is one of these which is considered below. A recommendation made last year, 'don't give two without review' was made in the context of concern about over-transfusing patients with risk factors for transfusion-associated circulatory overload. This should not be taken as a rule to apply to all transfusions, particularly in the face of haemorrhage where transfusion of more than one unit is an appropriate clinical decision. Good patient blood management seeks to ensure that the transfusion management is appropriate for each individual patient.

Transfusion at night – a change in recommendation

In 2003 SHOT reported that 50% of instances of incorrect blood component transfused occurred out-of-hours and as a consequence made the recommendation that '**transfusion should only take place at night if clinically essential**' (2001/2 Annual SHOT Report, 2003). This recommendation was based on the number of reported errors made at night both in laboratory testing and bedside administration and because in general fewer nursing and medical staff are available on wards at night (particularly after 20:00) so that clinical monitoring and support in the event of a reaction may be suboptimal.

Wrong application of this recommendation has endangered patients

Unfortunately this recommendation has been misinterpreted in some hospitals as a rule never to transfuse at night. This has resulted in clinically unacceptable delay in some cases of urgent and necessary transfusion contributing to death (Annual SHOT Report 2013 (Bolton-Maggs et al. 2014)).

Some elective transfusions may need to be performed out-of-hours

People who need regular red cell transfusions (particularly those with thalassaemia major and some renal patients) may prefer to have transfusion in the evening or at a weekend so as to minimise time lost from education or employment. An increasing number of patients with sickle cell disease are now also on long-term transfusion regimens. Recommended standards of care for such patients (Yardumian et al. 2008, West Midlands Quality Service Review 2014) are that elective transfusions are offered out-of-hours, often in a day unit area open for extended hours into evenings and/or weekend days. This is encouraged, and should be offered at all specialist haemoglobinopathy units, provided that staffing and monitoring is appropriate (see below).

Arrange pre-transfusion testing for elective transfusions at optimal times

Routine pre-transfusion testing for elective transfusions should not be done outside core hours unless there are adequate numbers of appropriately trained staff, particularly as many of these patients have complex transfusion requirements which may require additional testing and/or sourcing of special units.

Are more errors made out-of-hours now?

We have reviewed cumulative data on the time of day/night when incorrect component transfusions occurred between January 2010 and December 2014. The consistent pattern is that the majority, overall 626/807 (77.6%), now occur during normal working hours (defined in SHOT reporting as 08:00 to 20:00 on any day of the week including weekends).

Since the original recommendation in 2003 there have been many changes in laboratory and clinical practice, particularly the move towards shift work in the laboratory (although this may still mean lone-working overnight), the introduction of competency assessment and the Blood Safety and Quality Regulations (BSQR), which may have resulted in improved safety at night. There may be fewer transfusions occurring between 20:00 and 08:00 as a result of the previous SHOT recommendation, but the National Comparative Audit of red cell transfusion in medical patients (NCA 2011) showed that 14% (1298/9110) were in progress at 01:00. The authors were concerned that nearly three quarters of these were for 'anaemia'. The decision to transfuse these patients may not be appropriate, and every year, including in 2014, SHOT receives reports of patients transfused inappropriately for iron and other haematinic deficiency (see Chapter 10 Avoidable Delayed or Undertransfusion (ADU)).

Revised recommendation:

- Transfusions should be given with the same attention to patient observations whatever the time of day or night
- Transfusions at night must proceed where there is a clear clinical indication, and may be given as long as the staffing is sufficient to permit transfusion according to the standards defined in the BCSH guideline on administration of blood components 2009 (BCSH Harris et al. 2009). These standards include adequate pre-transfusion assessment, observations at 15 minutes after the start of each component and regular visual observation throughout the transfusion
- Decisions to transfuse should not be made simply on the basis of the haemoglobin result, but taking into account the full medical history, the patient's current medical condition and the wishes of the patient. Junior medical staff should review the patient, consult the case notes and take advice from senior medical staff before deciding to transfuse at night, particularly when the team concerned are not familiar with the patient's case and are not responsible for the overall management plan

Action: Trust/Health Board Chief Executive Officers, Hospital Transfusion Teams, Medical Directors responsible for all clinical staff

New recommendation for transfusion-related acute lung injury (TRALI)

Three TRALI 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. The cryoprecipitate pools contained 3 donations from females which contained HLA antibodies with 6 concordant specificities.

All UK Blood Services now use male donors to provide 100% fresh frozen plasma (FFP) and plasma for platelet pooling. This practice should, if possible, be extended to cryoprecipitate production across all UK Blood Services.

Recommendations

- UK Blood Services should avoid the use of female donor plasma in the production of cryoprecipitate whenever possible
- All UK Blood Services are encouraged to refer cases of suspected transfusion-related acute lung injury (TRALI) to the independent TRALI intensive care experts for assessment before laboratory investigations are initiated

Action: UK Blood Services

References

Bolton-Maggs P, Poles D et al. (2013) **Annual SHOT Report 2012** www.shotuk.org

Bolton-Maggs P, Poles D et al. (2014) **Annual SHOT Report 2013** www.shotuk.org

BCSH Harris A M, Atterbury CLJ et al. (2009) **BCSH Guidelines on the administration of blood components** http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf [Accessed 30/03/2015]

NCA (2011) **Audit of Use of Blood in Adult Medical Patients** www.hospital.blood.co.uk/audits/national-comparative-audit-reports/ [Accessed 21/03/2015]

SHOT Report 2001/2 (2003) www.shotuk.org

West Midlands Quality Service Review (2014) **Health Services for People with Haemoglobin Disorders version 2**. WMQRS-QS-combined-adult-and-child-haemoglobin-disorders-V2-D18-final-20140609_1402676041(2).pdf

Yardumian A et al. UK Thalassaemia Society (2008) **Standards for the Clinical Care of Children and Adults with Thalassaemia in the UK** available from office@ukts.org

Medicines and Healthcare products Regulatory Agency (MHRA) Report on Blood Safety and Quality Regulation in 2014

6

Author: Mike Dawe and Chris Robbie

Introduction

The United Kingdom (UK) Blood Safety and Quality Regulations (BSQR SI 2005/50 as amended) 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 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 20th March 2015.

Key messages

- Developments in the way the MHRA analyse SABRE data have given the opportunity to look at the different root causes and contributory factors to a number of different types of error
- Human error accounts for 97.8% of serious adverse event reports to the MHRA
- 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 - see also Chapter 8 Investigating Transfusion Incidents using Root Cause Analysis in the Annual SHOT Report 2012 (Bolton-Maggs et al. 2013). Further investigation may identify improvements to the overall quality system that could have long lasting preventative outcomes
- The most cited inspection deficiency is 'Investigation of anomalies – CAPA (corrective and preventative action)'. Sites did not have a CAPA handling procedure in place and details of root cause were poor

Summary of reports n=1110

2014 SABRE data have been analysed by the MHRA haemovigilance team in order to identify common errors and to make recommendations for improvements to 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 764 SAE confirmation reports were submitted to Europe, or 283 SAEs per million components issued, or 0.03%. 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 in which to receive a blood transfusion, but further efforts can be made to improve the quality and safety of blood and blood components.

Human error accounts for 97.8% (747/764) 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 - see also Chapter 8, Annual SHOT Report 2012, (Bolton-Maggs et al. 2013). 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
- The report completion dates could be different i.e. a report is included in the annual figures if it has been confirmed within the reporting year. For example, a report confirmed on SABRE in December 2014 may not be completed on the SHOT database until January 2015
- MHRA does 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) administration
- MHRA does not include reactions to blood products such as Octaplas® (solvent-detergent fresh frozen plasma (SD-FFP))

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

SABRE report data

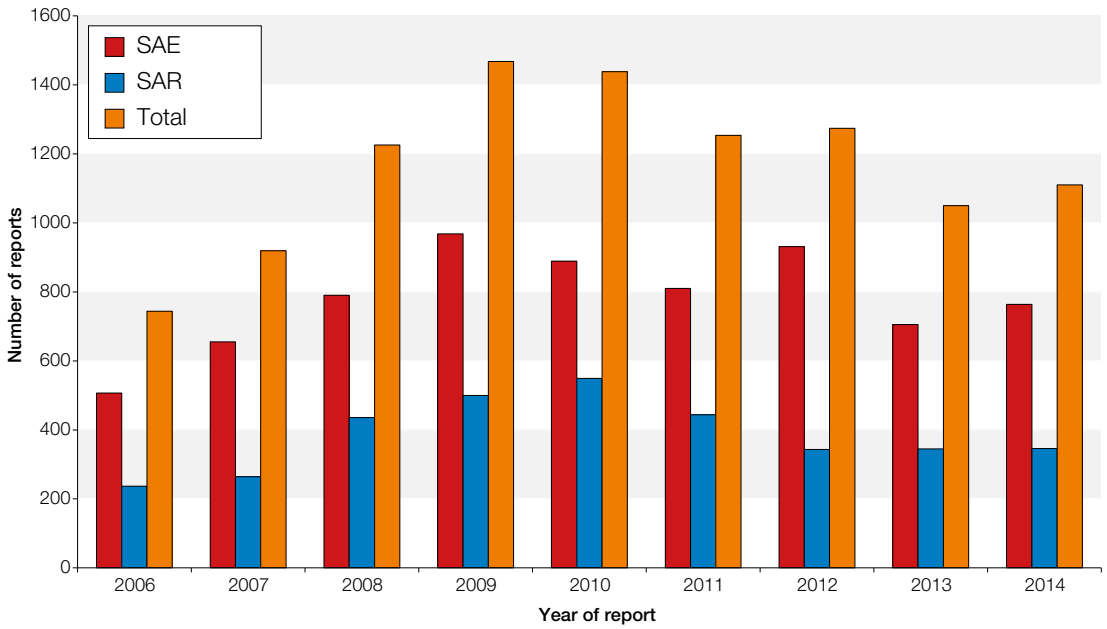
Table 6.1 below displays the total number of SABRE confirmation reports that were submitted and satisfy the European Union (EU) reporting criteria for SARs and SAEs since 2006.

Table 6.1: Submitted SABRE confirmation reports 2006–2014

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

The number of SAEs reported shows an increase of 59 reports, 8.4% (705 in 2013, 764 in 2014), from 2013 but still shows a reduction, 21.1% (968 in 2009, 764 in 2014), in reports received, from the peak in 2009. Reporters are encouraged to seek advice from the SABRE helpdesk if they are unsure if an event is reportable or not. The general trend of the number of reports received, by year, is shown in Figure 6.1.

Figure 6.1: SABRE reports 2006–2014



Serious adverse events (SAE) n=764

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.

	SAE specification				
SAE deviation	Product defect	Equipment failure	Human error	Other	**Total**
Whole blood collection	0	0	24	0	**24**
Apheresis collection	4	0	1	0	**5**
Testing of donations	0	1	9	1	**11**
Processing	0	0	11	0	**11**
Storage	0	6	205	0	**211**
Distribution	0	1	23	0	**24**
Materials	1	0	0	0	**1**
Other	0	3	474	0	**477**
Overall total	**5**	**11**	**747**	**1**	**764**

Table 6.2: 2014 SAE confirmation reports by deviation and specification

Human error accounts for 97.8% (747/764) of SAE reports received with storage accounting for 27.6% (211/764). There is an upward trend from the SAEs reported in 2013, please see Table 6.2 above and error reports, by deviation, Table 6.3 below.

SAE deviation	2013	2014	Change
Whole blood collection	18	24	+6
Apheresis collection	3	5	+2
Testing of donations	3	11	+8
Processing	14	11	-3
Storage	211	211	0
Distribution	24	24	0
Materials	2	1	-1
Other	430	477	+47
Overall total	**705**	**764**	**+59**

Table 6.3: SAE confirmation reports by deviation 2013-2014

Although the numbers in most reporting categories are similar to the 2013 data there is an increase (430 to 477) in the number of SAEs that fall into the 'other' category (Table 6.3).

Storage data n=211

Storage remains the second largest error. The MHRA has broken this category down further to try and identify specific storage error subtypes, Table 6.4.

Storage sub-classification	2012	2013	2014	Change from 2013
30 minute rule	21	9	13	+4
Component expiry	55	56	77	+21
Failure to action alarm	28	18	14	-4
Incorrect storage of component	42	73	42	-31
Miscellaneous	0	0	4	+4
Return to stock error	20	13	15	+2
Sample expiry	12	18	18	0
Security	13	7	7	0
Storage temperature deviation	26	17	21	+4
Total	**217**	**211**	**211**	**0**

Table 6.4: SAE storage error sub-classifications 2012-2014

The greatest increase in storage errors reported is in 'component expiry' (56 in 2013 to 77 in 2014). Reports fall into this category if the quality system has failed to identify and remove components that have expired or are expiring according to the laboratory's local procedures. The main reasons for this increase may be:

- A genuine increase in the number of mistakes made when following the process
- An increase in awareness of reporting these types of incidents

Many laboratories rely on a morning check to remove expired components, but often this was carried out too late and, as a result, clinical staff had already used the blood overnight. In general a successful CAPA needs to be implemented that involves establishing a process to remove expired components earlier, either at midnight or the evening before the unit was due to expire.

The number of reports classified as 'incorrect storage of components' has reduced from 73 in 2013 to 42 in 2014. In these incidents components have either been placed in the wrong storage conditions (e.g. platelets in a refrigerator) or in unmonitored storage equipment (e.g. a ward drug refrigerator). This reduction may be a reflection of a more robust and effective CAPA such as raising awareness through better training regimes.

Other n=477

As 'other' is the largest category of SAE reports, the MHRA haemovigilance team has created sub-categories to further analyse this type of error, Table 6.5.

Table 6.5: SABRE reports, subcategory 'other', 2012-2014

Subcategory	2012	2013	2014	Change from 2013
Incorrect blood component selected and issued (IBCI)	127	100	135	+35
Data entry error (DEE)	81	59	56	-3
Component labelling error (CLE)	75	82	85	+3
Sample processing error (SPE)	76	61	70	+9
Pre-transfusion testing error (PTTE)	64	53	68	+15
Component available for transfusion past de-reservation date (CATPD)	42	12	9	-3
Component collection error (CCE)	30	21	29	+8
Failed recall (FR)	11	26	15	-11
Expired component available for transfusion (ECAT)	7	10	4	-6
Incorrect blood component ordered (IBCO)	5	3	5	+2
Incorrect blood component accepted (from supplier) (IBCA)	4	2	0	-2
Delayed component supply (BE only) (DCS)	2	0	0	0
Unspecified (UNS)	4	1	1	0
Total	**528**	**430**	**477**	**+47**

Incorrect blood component issued (IBCI) errors remain the largest 'other' subcategory, comprising 28.3% (135/477) of all 'other' reports received. Although SABRE does not have the facility for reporters to enter the exact time 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'.

Pre-transfusion testing errors (PTTE) comprised 14.3% (68/477) of the 'other' errors reported. This is an increase of 28.3% (53 in 2013, 68 in 2014). The most common failures are where pre-transfusion tests were not initiated or completed before components were issued to a patient. Specific reports have included units being issued without an antibody identification test being completed on the recipient's screening sample. A regular theme in reports is that the error occurred due to poor communication at handover between staff.

One notable area of improvement is the reduction in component available for transfusion past de-reservation date (CATPD) errors reported (Table 6.5), 78.6% (42 in 2012, 9 in 2014). SAEs where an expired component is discovered in the clinical area, prior to the local de-reservation time are categorised as 'other' and sub-categorised as CATPD. This improvement may be due to changes to the overall process with procedures in place to identify and remove components before their expiry.

Summary of human error

In order to understand human error the SABRE team has developed further categories which can be applied to the report narratives so that a possible link with a specific activity could be found. 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 quality management system (QMS) failure
- Incorrect procedure – process not properly described
- 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
Procedure steps not performed correctly	237
Procedural steps omitted/wrong procedure performed	184
Inadequate process	166
Incorrect procedure	28
Ineffective training	92
Inadequate training	21
Lapsed/no training	19
Total	**747**

Table 6.6: SABRE reports, human error subcategory 2014

These numbers show that the majority of errors are caused by process-related issues where staff do not perform, omit a step or follow an inadequate process. Typical examples are that staff have been distracted and/or interrupted by another member of staff and/or telephone call. The root cause of this error therefore is not just the interruption but the cause of the interruption, the telephone call and/or member of staff while they were carrying out a procedure. In addition staff have been interrupted during a process and picked it up again at the wrong step, such as failing to add the plasma in a manual crossmatch.

To avoid these errors it is suggested that organisations implement measures that effectively remove distractions and/or interruptions from the process. In one case the laboratory assigned an additional member of staff to a testing bench so that they could intercept telephone calls and so effectively removing the distraction of answering the telephone.

Human error associated with training is another area of concern. These errors may reflect laboratories using locum staff. The narratives in a selection of these reports suggest that a locum, who is new to the laboratory process, has made the error due to not being familiar with the set procedure. In this example the competency-based training of locum staff needs to be reviewed and improved.

Serious adverse reactions (SAR) n=346

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 (i.e. licensed medicines such as anti-D Ig, Octaplas® (SD-FFP), or coagulation factor concentrates should be reported to the MHRA via the Yellow Card scheme (http://yellowcard.mhra.gov.uk).

Summary of SAR report data

A reconciliation of SAR and SHOT data was presented as a joint SHOT and MHRA poster at the British Blood Transfusion Society (BBTS) conference 2014. This analysis concluded that there is significant underreporting of SARs to the MHRA, and therefore to the EU (Poles et al. 2014).

Reporters are reminded that it is a legal requirement, under European law, to report SARs as soon as known to the Competent Authority. Changes have been introduced to SABRE which have the following benefits:

- The changes are a first step to producing a single joint reporting system
- They should result in reporters meeting their legal requirements under the Blood Safety and Quality Regulations
- They will minimise the reporting burden on reporters for SAR reporting

To avoid any confusion the MHRA will only supply, in this 2014 Annual SHOT Report, total SAR figures reported to Europe, see Table 6.7. It is proposed that in future the classification of type and imputability will be assessed by SHOT and then reported to the MHRA for reporting to Europe. The purpose of this is to maximise clinical expert analysis of SARs so that consistency of SARs reported, by type and imputability, is achieved and previous differences in the data are avoided. At the time of writing this chapter this process is being discussed by SHOT and the MHRA. Reporters will be informed about the specific changes to the SAR reporting process once both organisations have reached agreement on a workable process.

To avoid the reporters going back through SARs that were reported to SHOT but not SABRE the MHRA has decided that these reports do not need to be retrospectively reported to the MHRA as the relevant information is already held on the SHOT database.

Table 6.7: SAR reports, by imputability, reported to SABRE only in 2014 n=346

	Imputability score				
	NA	0	1	2	3
SAR reports by imputability score	3	61	108	127	47

Table 6.8: Total confirmed 2014 SAR reports to SHOT and SABRE

	SABRE	SHOT
SAR reports confirmed in 2014	346	499

Table 6.8 shows the total number of SAR reports submitted to SABRE and SHOT. These numbers show that reporters have submitted substantially more to SHOT than SABRE in 2014. All SAR reports should have been reported to both haemovigilance organisations.

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.

Issues referred by the MHRA haemovigilance team to MHRA inspectors

On occasion the MHRA haemovigilance team will refer reports to the MHRA inspectors for advice or for their information. The inspectors review those reports and decide if any further action is required.

Referred cases will include:

- Major failures in the total quality management (TQM) system
- Reports of deaths associated with transfusion where the imputability level is 2 or 3
- Reports showing repeated failures in one aspect of the TQM

In 2014 the total number of referred reports was 206/1110 representing 18.6% of the total reports received.

MHRA inspection activity 2014

The following information has been provided by the MHRA inspectorate division.

Top 10 defect areas for critical majors at inspected organisations

The following table shows errors identified, by rank, at 32 inspections carried out by the Inspection, Enforcement and Standards (IE&S) Division in 2014. The percentages are derived from 69 Critical and Major deficiencies found at inspection.

Rank	Defect category	Percentage of critical / major deficiencies with this defect category
1	Investigation of anomalies – CAPA	13.7%
=2	Investigation of anomalies	6.5%
=2	Quality management – change control	6.5%
4	Personnel issues – training	5.0%
5	Personnel issues – duties of key personnel	4.3%
=6	Computerised systems – documentation and control	3.6%
=6	Quality management	3.6%
=6	Design and maintenance of premises	3.6%
=6	Equipment validation	3.6%
=6	Documentation - procedures	3.6%
=6	Design and maintenance of equipment	3.6%
=6	Warehousing and distribution activities (General storage temperature control and monitoring)	3.6%
*	Miscellaneous	38.8%

Table 6.9: Most frequent deficiencies observed at 32 blood sites (11 Blood Establishments)

Top five defects

Investigation of anomalies - CAPA

The main finding was that sites did not have a CAPA handling procedure in place. Investigations into incidents lacked depth and scope, especially when looking at patient safety implications. Reports lacked detail of the root cause analysis and therefore the sequence of events that led to the error. Without the appropriate investigation and identification of the root cause it is not possible to identify the appropriate CAPA.

In addition the timelines applied within the procedure did not follow a risk-based approach, neither identifying an appropriate timeframe, nor level of investigation and implementation of adequate control measures in line with the criticality of the incident.

It was also found, in some cases, that there was no formal process for the management and approval of extensions for investigations that were overdue according to the time limits detailed in the organisation's QMS.

Investigation of anomalies – other findings

Investigation reports were weak and failed to create a comprehensive record for subsequent review. Examples of this are detailed below:

- The report failed to address how the issue was initially identified
- The report assumed that no components/products were impacted but it was unclear on what basis this assumption was made
- No assessment was available of the operation of the equipment prior to the failure being reported
- The report was written and approved by one member of staff and lacked independent review

The majority of reviewed investigations had no clear outcome, and component/product disposition decisions were poorly described. In addition there was no overarching procedure governing the investigations of incidents where several disparate processes were involved. The reports failed to describe and adequately link the error(s) to the quality system making the report difficult to follow and confusing for staff.

Another common finding was that there was an inappropriate use of risk management techniques in that the criticality scoring matrix was only based upon actual patient harm and failed to consider potential harm. In addition, the scoring matrix inappropriately classified incidents as 'medium risk' when a severity of 5 (death) and recurrence of 1 or 2 was recorded.

Quality management – change control

Formal change control procedures continue to be problematical. Several examples can be found where change control procedures have not been carried out correctly, in sufficient detail and in an appropriate time frame. Change control procedures should be initiated with the appropriate amount of assessment and evidence. Examples were found where a change control has been initiated when the decision to change a system/process had already taken place and in retrospect. In some cases changes had been made without any evidence of a change control process ever being followed.

Personnel issues – training

Some organisations had weak training practices because of the following:

- Competency training against tasks and procedures was not formalised
- Training records for on call personnel did not include training against critical procedures such as the recall process
- Refresher training for ancillary personnel was not sufficiently frequent

Personnel issues – duties of key personnel

Key duties must be assigned to appropriately trained and competent members of staff. The following deficiencies were found:

- Staff participating in root cause analysis had not had any formal root cause analysis training
- Essential audits were not apparent, such as those demonstrating whether staff have received appropriate training for assigned tasks, e.g. being authorised to access and remove blood from blood banks
- There was a lack of ownership of the QMS by those outside quality assurance
- Good manufacturing practice (GMP) training was not in place for all temporary senior appointments and also for staff that required it for their specific role

IE&S summary

The 'Good Practice Guidelines for Blood Establishments and Hospital Blood Banks' is yet to be adopted by the European Commission; therefore the EU good manufacturing practices and the blood directives will continue to form the legal basis for inspection. However this guide is a direct interpretation of the relevant GMP guidance and is a useful reference tool for those responsible for the QMS.

The most cited inspection deficiency is '*Investigation of anomalies -CAPA*'. This and '*Investigation of anomalies*' will therefore remain an area of focus during inspections.

For further information on **MHRA and the Regulation of Blood** please refer to the MHRA website:

http://www.mhra.gov.uk/Howweregulate/Blood/BloodConsultativeCommittee/index.htm

http://www.mhra.gov.uk/Howweregulate/Blood/index.htm

References

Bolton-Maggs PHB (Ed), Poles D et al. (2013) **The 2012 Annual SHOT Report** http://www.shotuk.org [accessed 10 March 2015]

BSQR. Blood Safety and Quality Regulations (SI 2005/50, as amended) http://www.legislation.gov.uk/uksi/2005/50/contents/made [Accessed 30/03/2015]

Department of Biological Standardisation, OMCL Network and Healthcare CDBD (2013) **Good Practice Guidelines for Blood Establishments and Hospital Blood Banks required to comply with the EU Directive 2005/62/EC** http://www.edqm.eu/site/good_practice_guidelines_dec_2013pdf-en-31298-2.html [accessed 6/04/2015]

Poles D, Watt A et al. (2014). **Haemovigilance Reporting in the UK 2013 – Collaboration to reduce confusion.** Transfus Med 24, Suppl. 2, page 50

7 Near Miss Reporting (NM) n=1167

Author: Alison Watt

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.

Key SHOT messages

- Ensure a group check policy is in place as detailed in the British Committee for Standards in Haematology (BCSH) guidelines for pre-transfusion compatibility (BCSH Milkins et al. 2013)
- Identify patients fully at every stage, but particularly when taking a pre-transfusion sample and before spiking units for transfusion
- Laboratory staff should ensure all information technology (IT) systems are audited on a regular basis against the BCSH guidelines for the specification, implementation and management of IT systems in hospital transfusion laboratories (BCSH Jones et al. 2014). There should be a robust policy for any manual amendments
- All relevant near miss events should be reported to SHOT for improved learning opportunities

Near misses n=1167

There were 1167 near misses reported in 2014 compared to 996 reported in 2013. There continues to be a high number of reports of wrong blood in tube incidents (WBIT), representing 686/1167 (58.8%) of all near misses.

WBIT incidents are discussed in greater detail in Chapter 9, Incorrect Blood Component Transfused (IBCT).

Previous Annual SHOT Reports have commented that there might be a disinclination to report near miss incidents other than the most serious cases (such as WBIT incidents) that could result in transfusion of an incorrect component. This may be due to competing workload pressures. Non-WBIT near miss cases include all other serious errors that were identified before the patient was harmed. These could have led to transfusion of an incorrect or less suitable blood component or erroneous treatment related to anti-D immunoglobulin (Ig) prophylaxis (Table 7.1 shows the sub-categorisation of near miss events according to SHOT definitions). In 2014 there was an increase in reports of near miss cases other than WBIT incidents. These comprise 481/1167 (41.2%) of all near misses, compared to 353/996 (35.4%) in 2013 (Figure 7.1). Important lessons can be learnt from all near miss errors, so continued reporting is strongly encouraged.

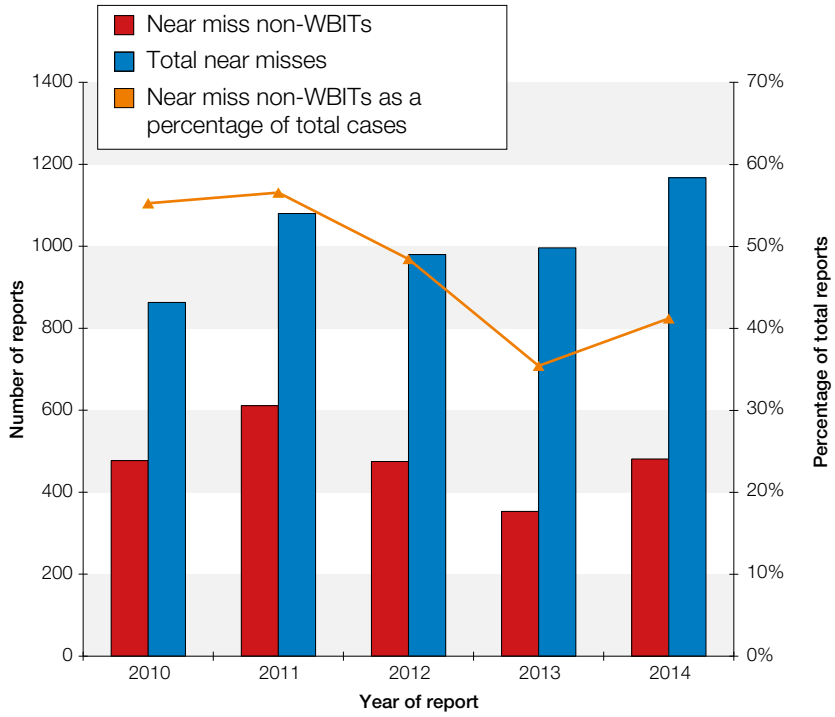


Figure 7.1: Near miss non-WBIT cases compared to total near misses 2010-2014

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.

Category		Chapter	Number of cases	Percentage of cases
Incorrect blood component transfused (IBCT)	Wrong component transfused (WCT)	Chapter 9	795	68.1%
	Specific requirements not met (SRNM)	Chapter 9	99	8.5%
Right blood right patient (RBRP)		Chapter 23*	118	10.1%
Handling and storage errors (HSE)		Chapter 24*	98	8.4%
Adverse events related to anti-D Ig		Chapter 25*	43	3.7%
Avoidable, delayed or undertransfusion (ADU)		Chapter 10	14	1.2%
Total			**1167**	**100%**

These chapters can be found in the 2014 Annual SHOT Report: Web Edition – www.shotuk.org

Table 7.1: Categorisation of all near misses according to SHOT definitions

Importance of group-check policy

Data from WBIT incidents were analysed to highlight cases where the reporter mentioned the policy of requiring a group-check sample on a previously unknown patient, as recommended in the 2012 BCSH guidelines for pre-transfusion compatibility procedures (BCSH Milkins et al. 2013). As this question is not specifically asked in the near miss questionnaire, the analysis in Table 7.2 is only a small snapshot of cases.

Outcome of testing a group check sample	Number of cases	Percentage of cases
Original sample was WBIT	20	74.1%
Group-check sample was WBIT	3	11.1%
Circumvention of process (both samples taken at same time)	3	11.1%
Other (request for check sample alerted sample taker to error with original)	1	3.7%
Total	**27**	**100%**

Table 7.2: Outcomes of testing a group-check sample on a previously unknown patient n=27

In addition to these 27 cases, root cause analyses of a further 12/686 (1.7%) WBIT incidents indicated that implementation of a group-check protocol was to be considered as a corrective action following the incident. In 2012 SHOT recommended 'there should be strict adherence to the requirement for a group-check sample on patients without a historical blood group' and that recommendation remains active.

Case 1: Unexpected repeat sample prevents selection of ABO-incompatible blood for a preoperative patient

A WBIT incident was detected due to blood group discrepancy, which occurred three days before the group-check sample rule was implemented in this Trust/Health Board. At the time a group-check sample was not a requirement, but the anaesthetist sent a repeat crossmatch sample preoperatively. If that extra sample had not been sent, the initial sample previously received from the emergency department (ED) would have been used. The ED sample grouped as A D-positive, but the repeat sample showed the patient was actually B D-positive.

Case 2: WBIT at hospital X discovered through a linked database at hospital Y

A sample grouped as A D-positive in hospital X. There was no previous history for this patient. Approximately two weeks later a sample from the same patient was received at hospital Y, which grouped as O D-negative. The two hospitals have linked databases, so the second hospital noticed the groups did not match. A repeat sample confirmed the group as O D-negative and the investigation revealed the first sample could not have been from this patient.

Quality management systems (QMS)

BCSH guidelines for pre-transfusion compatibility procedures (BCSH Milkins et al. 2013) recommend laboratories to have a documented QMS and clinical areas should have equally robust quality processes. Analysis of SHOT near miss cases shows that errors often cannot be detected by the quality processes and Table 7.3 shows that 458/1167 (39.2%) of cases were only detected by chance. Many near miss errors, particularly WBITs, are detected by testing anomalies in the laboratory, 525/1167 (45.0%). This is part of the QMS, but has an element of good fortune that the test result differed on this occasion to highlight the error. The laboratory QMS detected a further 57/1167 (4.9%). Quality processes in the clinical area, particularly the final bedside check, can also prevent patient harm by detecting errors before transfusion, 127/1167 (10.9%).

Table 7.3: Near miss detected by quality management system or good fortune

Near miss detection	Number of cases	Percentage of cases
Laboratory QMS	57	4.9%
Laboratory QMS, but detected because ABO/D or other test result differed	525	45.0%
Clinical quality processes	127	10.9%
Accidental detection, QMS would not have detected the error	458	39.2%
Total	**1167**	**100%**

Case 3: Mismatch with historical group detects that sample was taken from person in the house next door

A crossmatch sample was taken by the community team, but the group was determined to be different from the historical group. The investigation showed the sample had mistakenly been taken from the person living next door to the patient. The second individual had not questioned the nurse as he himself was awaiting a nurse to give him an injection.

IT and analyser-related near miss reports n=6

Unusually, in 2014 there were several reports of apparent equipment failures leading to testing problems, n=6. All incidents were in separate Trusts/Health Boards and, where stated, different analysers were implicated. These issues are summarised in Chapter 11 Summary of Events Originating in the hospital transfusion laboratory.

Further analysis of total near miss errors n=1167

Tables showing the sub-categorisation of near miss errors consistent with those in previous Annual SHOT Reports (2010-2013) can be found in the supplementary information on the SHOT website www.shotuk.org.

COMMENTARY

WBIT incidents continue to be the most commonly reported near miss error, 686/1167 (58.8%) of all near misses. A group-check policy can improve the chance of detecting a sampling error and this policy should be implemented in every Trust/Health Board as detailed in the BCSH guidelines for pre-transfusion compatibility procedures (BCSH Milkins et al. 2013) and recommended by SHOT in the 2012 Annual SHOT Report (Bolton-Maggs et al. 2013).

Misidentification of patients is a common theme in many near miss reports, especially those involving WBIT or when collecting blood components for transfusion. Patients should be carefully and fully identified at every stage, but particularly when taking a pre-transfusion sample and before spiking units for transfusion.

The United Kingdom Transfusion Laboratory Collaborative (UKTLC) has recommended that all laboratories have complete walk-away automation which is in use 24 hours, 7 days a week, with bidirectional interfaces to the laboratory information management system (LIMS) (Chaffe et al. 2014). A small number of testing errors (n=6) were reported to have resulted from unexpected performance within IT systems, although exact causes were not known in all cases and may have involved some manual input. Laboratory staff should ensure all IT-based equipment and interfaces are fully validated and tested with all possible operational and performance scenarios. There should also be a robust policy for any manual amendments that are made to automated results.

An incorrect blood component transfused (IBCT) is the most dangerous transfusion error, but all near misses flag up risk of harm to patients, so increased reporting of these may highlight where quality improvements could be made. All appropriate near miss events should be reported to SHOT for improved learning opportunities.

References

BCSH Jones J, Ashford P et al. (2014) **Guidelines for the specification, implementation and management of IT systems in hospital transfusion laboratories**. Transfus Med 24(6), 341-371
http://www.bcshguidelines.com/documents/IT_guidelinesAug14_final.pdf [accessed 10 March 2015]

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

Bolton-Maggs PHB (Ed), Poles D et al. (2013) **The 2012 Annual SHOT Report.**
http://www.shotuk.org/wp-content/uploads/2013/08/SHOT-Annual-Report-2012.pdf [accessed 10 March 2015]

UKTLC Chaffe B, Glencross, H, et al. (2014) **UK Transfusion Laboratory Collaborative: minimum standards for staff qualifications, training, competency and the use of information technology in hospital transfusion laboratories 2014**. Transfus Med 24, 335–340
http://onlinelibrary.wiley.com/doi/10.1111/tme.12153/full [accessed 10 March 2015]

8 Human Factors

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Last year we noted that in 2013 77.6% of all incidents reported to SHOT and 68.8% of all reports to the Medicines and Healthcare products Regulatory Agency (MHRA) were caused by mistakes, often multiple (Bolton-Maggs, Poles et al. 2014). The percentages are very similar for 2014. Despite this and other evidence of the contribution of mistakes to poor patient outcomes throughout the health system, there has been little progress in the past decade. More recently the science of human factors has been applied to healthcare with the recognition that people cannot be made perfect ('human error is a symptom of a bad design' Harold Thimbleby), rather attention should be diverted towards improving the working environment to minimise the risks (ergonomics). The Human Factors Concordat (NHS England 2013) has been followed by a draft report from Helen Hughes, the roadmap for patient safety (Clinical Human Factors Group 2014). It notes that 'there has to be a transformational change in approach to the commissioning and delivery of care, how we lead, train and support our staff and how we engage actively with patients'. In addition 'human factors has also shown that the most effective way to improve safety is to design services so that the possibility of error is reduced and, if an error happens things fail to safety, not danger'. The report lists the many organisations that are starting to make progress and provides a challenge to all to get involved.

There is increasing concern about the impact of reductions in numbers and seniority of staff in the National Health Service (NHS), such that the National Institute for Health and Care Excellence (NICE) has set up up a Safe Staffing Advisory Committee (SSAC). Anecdotal evidence, including SHOT reports, cites inadequate staffing as a source of error. Clinical overload was noted in the press in January 2015 when at least 17 Trusts or Health Boards declared major incidents, enabling them to bring more staff in, when their accident departments became overstretched; NICE is developing guidelines (anticipated publication May 2015) for safe staffing and the draft for consultation was published January 16th and available for a month. This recommended a staffing ratio for Emergency Departments of 1 nurse to 4 patient cubicles in minors and majors, but 1:1 in triage and 1:2 in resuscitation areas.

'Sign up to safety' is a new national patient safety campaign that was launched in June 2014 (see www.england.nhs.uk/signuptosafety/about/). The mission is to strengthen patient safety and make the NHS the safest health system in the world. The Secretary of State for Health has indicated the intention to halve avoidable harm over the next three years and thus save 6000 lives. This is supported by NHS England and the NHS Litigation Authority which can offer financial incentives to hospitals who support the plan, and the Care Quality Commission who will review Trust's plans. Individuals and organisations are asked to sign up to 5 safety pledges:

- Put patient safety first. Commit to reduce avoidable harm in the NHS by half and make public the goals and plans developed locally
- Continually learn. Make their organisations more resilient to risks, by acting on the feedback from patients and by constantly measuring and monitoring how safe their services are
- Honesty. Be transparent with people about their progress to tackle patient safety issues and support staff to be candid with patients and their families if something goes wrong
- Collaborate. Take a leading role in supporting local collaborative learning, so that improvements are made across all of the local services that patients use
- Support. Help people understand why things go wrong and how to put them right. Give staff time and support to improve and celebrate the progress

It is essential that all clinical and laboratory staff understand their responsibility to report adverse incidents. This has been encouraged for at least the past decade and emphasised in the Francis (Francis 2013) and Berwick (Berwick 2013) reports. Doctors are now required by the General Medical Council (GMC) to participate in adverse event reporting. Doctors 'must contribute to confidential enquiries and to adverse event recognition' (GMC 2013). When transfusion has been a part of any poor patient care the transfusion team in the hospital should be informed and be able to participate in the review.

Support for those who make mistakes is also encouraged (Edrees and Federico 2015) so it is disappointing to hear that staff have been dismissed for errors which are also made in other organisations by many individuals (failure to perform bedside checks). Such individuals are 'second victims'. The development of a robust error-reporting culture with the statutory 'duty of candour' should be accompanied by the development of formal organisational support programmes as recommended by Edrees and Federico and others (Denham 2007) and demonstrated by the Medically Induced Trauma Support Services (MITSS 2010).

We reported last year that many, often multiple, errors are made during the transfusion process and the data from 2014 have been analysed in a similar way, but we have also attempted to describe these events by three primary categories:

- Failures in patient identification
- Failures of communication
- Failures of documentation

These are three areas of risk highlighted in the 2009 British Committee for Standards in Haematology (BCSH) guidelines on the administration of blood components (BCSH Harris et al. 2009). While the first error may be in the clinical area (e.g. failure to request specific requirements such as irradiated components) or in the laboratory (e.g. the biomedical scientist does not look for the historical transfusion information), there are often errors in both as will be evident from the following analyses (and others are described in Chapter 9, Incorrect Blood Component Transfused). Serious outcomes often have multiple contributory factors from different hospital areas as shown in the example below.

We note with concern that a transfusion practitioner only became aware in 2014, when she saw it reported in the local press, of one death in her hospital in 2013 where delayed transfusion had played a part. She subsequently reported this to SHOT but had not been invited to participate in any part of the incident review. This case demonstrates many communication and documentation failures.

Case 1: Delayed transfusion in an elderly man with gastrointestinal (GI) haemorrhage and coronary artery disease

A 69 year old man was admitted to the emergency department from the anticoagulant clinic because of haematemesis (a history of dark vomit in the night) and melaena (2-3 days of dark stools). He had a history of coronary artery disease. He was triaged at 17:05 and seen promptly by a doctor. His observations were stable.

At 17:31 a venous blood gas showed Hb 54g/L and admission to the medical admissions unit for transfusion was planned at 18:05. Intravenous (IV) fluids were started. His Hb from the laboratory was 86g/L and international normalised ratio (INR) 3.3. At 19:00 his blood pressure (BP) was falling (100mmHg systolic) although his pulse rate did not increase (as he was taking beta blockers). The IV fluid rate was increased and he was given 5mg vitamin K (at 20:19) and following discussion with a consultant haematologist at 19:30 prothrombin complex concentrate (PCC) was also advised. This was given 2 hours later.

At 22:25 (>5 hours since arrival) he was transferred to the acute medical unit (AMU) but by then had developed chest pain, and an electrocardiogram (ECG) showed fast atrial fibrillation (AF) at 152 bpm. The patient was not seen by a doctor or clerked. The nurse was distracted by other sick patients; regular observations of vital signs were not made because she did not know how to use the electronic device confidently.

At 01:06 (8 hours from admission) he again complained of chest pain. There are no notes or observations between 22:25 and 01:30 when he suffered cardiac arrest. He then received 2 units of blood (about 9 hours from original presentation) and a further 4 after intubation and ventilation. ECG confirmed myocardial infarction. He did not recover and died on the 8th day of admission due to hypoxic brain injury caused by hypovolaemic shock and GI haemorrhage due to diverticular disease of the colon.

The hospital investigation concluded that 'the combination of anaemia/hypovolaemia, likely ongoing bleeding and the cardiac strain from fast AF in the context of moderate coronary artery disease all contributed to the cardiac arrest'. The inquest was told that the hospital's system 'broke and failed' this man, and his widow commented 'one person after another made a mistake that should not have been made. He was let down by everybody….All the protocols were broken'.

Several errors in his management were identified leading to delay in assessment and management. The early warning scores have been revised to ensure appropriate escalation to more experienced staff, staffing and rotas have been reviewed.

This case shows problems with documentation (no observations on the ward) and communication (failure to escalate his deterioration to more experienced nursing and medical staff).

Patient identification (ID)

Failure to identify the correct patient may result in death. ABO-incompatible red cell transfusions often involve at least two errors (see below). However, taking blood from one patient and labelling it with another patient's details may be a single error which leads to an ABO-incompatible transfusion if the patient does not have a historical record. This cause of wrong blood transfused should be prevented by the recommended 'group-check' second sample for patients who have never been transfused before (BCSH Milkins et al. 2013).

The two common errors are collection of the wrong unit or component from the laboratory followed by failure to perform the bedside checks properly or at all. The unit is checked in a quiet treatment room away from the patient, a wrong practice which by default becomes standard practice, followed by failure to check again as the unit is connected to the patient, in some instances by a third nurse who was not part of the checking process. This is an example where an additional step has made the process less safe, and resulted in two ABO-incompatible transfusions in two different hospitals.

SHOT recorded 10 ABO-incompatible red cell transfusions in 2014, all caused by clinical errors, but only 1 with serious harm. This shows little change compared to recent years (9 in 2013, 12 in 2012). In 7/10 cases there was a failure in correct patient identification, with no bedside checks performed.

Actions taken by the institutions varied but in one case 2 nurses were dismissed, in other instances the staff are supported, retrained and their environment modified. Good root cause analysis aims to determine why the mistakes were made, and to look for systems errors rather than apportioning blame. SHOT has cumulative evidence that staff do not follow the protocols and procedures and we need to understand why. Do we need to change the procedures? (Bolton-Maggs et al. 2014).

In 7/10 clinical errors red cell transfusions of group A were given to group O patients; 2 were given in 'emergency' situations in theatre and 3 others were 'urgent'. One patient was transfused during an emergency aortic aneurysm repair, the second such operation that this team had performed that night. When the error was noted, the patient was treated for renal impairment with haemofiltration and also developed jaundice. Another incident occurred in a young woman during a liver transplant for fulminant hepatic failure. The patient (group O) was bleeding and a new anaesthetist who was an observer 'helped' by taking the unit of blood from the refrigerator and connected it; it was the wrong one (group A). It was noticed by the operating department practitioner when less than 50mL had been transfused. The patient died from complications following respiratory arrest. The root cause analysis resulted in several changes to the surgical procedures. Patients had symptoms or signs of haemolysis in only 4/10, so only these 4 would currently be MHRA-reportable.

False identity

Every year SHOT receives reports where a transfusion has been administered to a patient whose identity is wrong. These are not errors in patient identification made by health care personnel but are instances where the patient has given a false identity. We report these to make staff aware of this potential problem. Three cases were reported in 2014. There was a further near miss error where a member of staff used her own identity for blood samples taken from a family member which was detected because the historical blood group differed.

Case 2: Staff member involved in deliberate identity fraud

A blood group did not match the patient's historical record. Haematology and chemistry samples sent at the same time were rejected and repeats of all samples requested. The investigation revealed that the test requests were initiated by a member of staff. The samples had been taken from a family member of the staff member, but labelled with the staff member's own details. The member of staff returned to work after suspension and re-training.

Case 3: A pregnant woman conceals her identity

A 24 year old woman underwent an ultrasound scan at a hospital where she was advised to have a termination of pregnancy. She attended another hospital giving a friend's name for identity but her own father as the next of kin. She underwent a surgical termination which was complicated by massive haemorrhage requiring transfusion with red cells, fresh frozen plasma (FFP) and cryoprecipitate, emergency intervention and uterine artery embolisation followed by admission to the intensive therapy unit (ITU) all at the first hospital. When her father was called in he confirmed she was his daughter but that the name on her wristband was not hers.

Case 4: A case of false identity

A 48 year old man was admitted with massive gastrointestinal haemorrhage related to alcoholic liver disease. He was transfused and admitted to the high dependency unit (HDU). When he started to deteriorate staff matched names tattooed on his body with names in his mobile phone and thus made contact with his mother and ex-wife. These relatives informed staff that the name he was using was not his, and that he was known to use 3 or 4 different identities. He died and the laboratory information management system (LIMS) now has a record of his false identity matched to his transfusion pack. This was merged with his true identity, but it is not known if there is a real person with those details. The records for all his known aliases have been marked with 'deceased'.

Case 5: Another case of false identity

A 33 year old woman from the travelling community gave the wrong identity on admission. She required surgical amputation for necrotizing fasciitis and received a blood transfusion while on ITU. Her family members later confirmed her correct details. The identity that she used was that of another 'live' patient on the LIMS but it was unclear whether this lady had used this ID before or whether it was another patient so warning flags were placed on both records to ensure that identity is checked before release of any blood components. All the medications were similarly tracked to the wrong ID.

Communication

The transfusion process requires participation by several individuals from different professional groups. Because of this it is not difficult for communication failures to result. Different professionals may not understand each other's scientific or professional language, for example an expert in the red cell immunology laboratory assumed a better knowledge of transfusion and serology than the on call hospital transfusion laboratory biomedical scientist possessed, who was usually based in biochemistry. Communication failures at handover were also noted in the MHRA review of SAEs.

Communication breakdowns occur between different departments and wards within hospitals as patients are transferred between the emergency department and wards (poor handovers), and particularly where there is shared care between different hospitals. Failures of communication are reported within hospitals with transplant patients as well as between the transplant centre (hub) and the spoke hospital to which the patient returns.

Examples are given below:

Case 6: Death where delay contributed to outcome

A 64 year old man attended the emergency department (ED), vomiting, hypotensive with a bradycardia. Two hours later (13:30) he suddenly collapsed. Two separate grouping samples were taken at 13:30 and 13:45; the laboratory was telephoned to say the samples were on their way for a patient with suspected ruptured abdominal aortic aneurysm (AAA). When the samples arrived they were not labelled as urgent and there had been no request to activate the major haemorrhage protocol (MHP). Laboratory staff concluded that no blood was required because the 4 units on the request form had been crossed out. Both samples had been processed by 14:30. A telephone call was received from theatre at about 15:00 asking where the blood was, the MHP was then activated. The components arrived at 15:28, the patient had received about 400mL by cell salvage, but died from circulatory collapse.

There was poor communication by both teams. The consultant in ED could have activated the MHP, the laboratory staff could have followed up the request, the surgical team did not check availability of blood prior to surgery and the O D-negative units could have been used. Review of this incident led to improvements in the roles of different individuals in the MHP, and laboratory staff are to make contact with clinical areas when there is confusion about what is required.

Case 7: Delay because of wrong assumptions

A 66 year old woman was planned for emergency surgery for a bladder tumour and the consultant requested that 2 units of red cells should be crossmatched. As the foundation year doctor was about to take the sample a phlebotomist came to the ward so the doctor asked her to do it. At this point there was a communication failure. The sample was not flagged as urgent, nor was a porter advised to collect it. It sat in the collection tray in the ward. The surgery was delayed by an hour when this was discovered as the blood was not available, the laboratory not having received the sample.

Shared care: several SHOT reports result from poor communication when care is shared within or between hospitals

Case 8: Failure to communicate diagnosis of a haemoglobin disorder

A woman aged 32 years received 2 units of red cells as an emergency in theatre for severe menorrhagia. She received a total 16 units of red cells prescribed by a junior doctor. She had been diagnosed with HbC at a different hospital and an extended red cell phenotype was performed at the regional transfusion centre. Advice had been given that she should have C-negative, K-negative and Fy^a-negative units (if available both Fy^a and Fy^b negative). However this information was not available to the transfusion laboratory, nor was the diagnosis of HbC disease noted on the request in this hospital. She had never been transfused before. The HbC disease was known on admission but was not discussed with a haematologist. The outcome of the review was to recommend a national database (this was in a devolved country that did not already have a national database).

Case 9: Failure to inform the laboratory about specific requirement for irradiated components

A 67 year old man had been treated for chronic lymphocytic leukaemia (CLL) at another hospital with fludarabine. At initiation of treatment at the second hospital no notification was made to the transfusion laboratory until he had received 10 units of non-irradiated components. Several different haematology doctors had requested the transfusion on different occasions. The hospital transfusion policy was amended to require the requestor to check for specific requirements.

Case 10: Failure to meet specific requirements by an unqualified prescriber

A 50 year old man whose care was shared with another hospital where he had received bendamustine did not receive irradiated platelets (given as prophylaxis against bleeding with a low platelet count due to relapsed non Hodgkin lymphoma). The nurse specialist in haematology had not read the patient notes where this information was recorded. In addition the first prescription of components for a new patient should be made by a senior doctor. The patient had not been issued with a warning card by the referring hospital.

The patient had received intensive chemotherapy in a tertiary centre but was reviewed in his local hospital more than 100 miles away. Although the plan had been for him to return to the tertiary centre for surveillance when he developed neutropenia he refused to go, and was treated locally with antibiotics and platelets (non-irradiated). After his second course of chemotherapy he did not want to return to the main centre for surveillance, and was again treated with non-irradiated platelets. After further discussion with the tertiary centre it became clear that he should receive irradiated components as he had been treated with bendamustine in 2012. A referral with this information had been faxed previously and was filed in the patient case notes but had not been seen by a consultant. The patient himself did not know of this specific requirement.

Case 11: Inappropriate and confused management of iron deficiency with too many opinions

A 41 year old man received 3 units of red cells as treatment for chronic gastrointestinal bleeding. His Hb was 36g/L. The management had already been agreed after review in clinic and was to give IV iron with oral iron and tranexamic acid, and to perform endoscopy. He had a history of alcohol abuse but had walked into hospital and was stable apart from a tachycardia of 120bpm. However, the medical registrar considered his condition to be unstable and a compromise was agreed to transfuse one unit and reassess; his Hb was then 43g/L. According to the local anaemia guidelines further transfusion might be reasonable. He was then transfused an additional 3 units overnight and his Hb was not repeated. He never received the IV iron, initially because the pharmacy could not supply it after 17:00, was not treated with tranexamic acid nor discharged on oral iron. Endoscopy was normal.

Case 12: Lack of leadership and delay in transfusion contributes to death

A 90 year old woman with a fractured neck of femur was scheduled for surgery 5 days after admission during which her renal function deteriorated. During surgery she lost 3L and was transfused 2 units of red cells. The MHP was activated by the consultant orthopaedic surgeon but when the laboratory staff communicated to the ward that the components were ready, there was disagreement by nursing and medical staff whether she needed this or not. There was an interval of more than 4 hours before the additional components (1 FFP, 1 cryoprecipitate, 1 platelets and another unit of red cells). She died the following day. There was communication confusion between theatre and the ward, and over the do-not-resuscitate (DNR) decision.

Better planning was required to assess her fitness for surgery, and in decisions about resuscitation. The staff did not know how actively she should be managed. Ideally surgery should be performed on the day of or day after admission together with 'rapid optimisation of fitness for surgery' (NICE 2011).

Patients undergoing transplants (solid organ or haemopoietic stem cell transplants) are at risk of receiving inappropriate ABO or Rh groups because of failures of communication to the laboratory and between hospitals. These are illustrated in Chapter 22 Summary of Incidents Related to Transplant Cases.

Many cases of communication failure also have poor or absent documentation, or documentation which is not consulted by the health care staff caring for the patient. In addition many cases exhibit poor clinical decisions which gives cause for concern.

What can be done to increase patient safety?

SHOT will be leading an investigation into transfusion practice to identify critical control points, with the aim of making recommendations for improved practice through redesign of the process. The objective will be to investigate whether the systems can move from Safety-I to Safety-II (Hollnagel 2014).

- Safety-I is the traditional state where safety is defined as 'nothing goes wrong'. This is paradoxically measured by counting incidents when things do go wrong, which is the current main function of SHOT
- Safety-II is a state where as far as possible 'everything goes right'. Lessons can be learned from what goes right and from how people intervene when something is perceived to be going wrong to prevent the situation becoming worse. Therefore, Safety-II concentrates on how to maintain safe practices under varying conditions, which is the day to day reality in busy healthcare environments. Safety management then becomes more proactive and less reactive

One aspect of proactive safety is noticing the unnoticeable, which can be demonstrated by Sherlock Holmes's curious incident of the dog in the night-time. Holmes noticed the dog did not bark, which would have been expected if a stranger had been the thief and from this observation he solved the case. Noticing when things do not go as expected in transfusion can prevent an incident. Often that is recognisable as a sense of unease or seeing a relatively trivial difference to normal expectation.

Case 13: Nurse noticing an unusual irradiation sticker prevents an inappropriate transfusion

A unit of platelets was collected and taken to the ward. When the nurse was checking the component she noticed that the irradiation sticker was still red and the word NOT was still visible. These stickers are designed to become black and obscure the word NOT when units are fully irradiated. The nurse noticed that the sticker did not look the same as usual and even though the sticker had been signed and dated as having been irradiated, the nurse contacted the laboratory to check. The nurse was advised to return the unit, as it had not been irradiated and thus prevented the patient receiving an incorrect unit.

Noticing when things went particularly well can also be beneficial. Examining what actually took place may show that sensible amendments have been made to cope with a variable situation; hence safety can be improved by observing what went right, as well as by exploring what goes wrong.

A report from the World Innovation Summit for Health (WISH) Patient Safety Forum (Pronovost 2015) identifies that healthcare generally operates according to three patient safety premises:

- Harms are inevitable, meaning healthcare feels helpless
- Data silos and superficial and segmented improvement efforts are natural; therefore, healthcare does not fully understand the benefit of systems that are well co-ordinated
- Heroism is the norm, meaning healthcare has grown accustomed to a care system that is wholly dependent on save-the-day actions

The forum has identified ten steps to improve patient safety and these are also applicable to transfusion safety:

- Policy and regulation to help rather than hinder safety improvements
- Patient safety is a core value of the culture
- Leadership influences patient safety
- Education leads to informed decision-making and system resilience
- Transparency and open disclosure are professional expectations
- Metrics are used to evaluate progress and success
- Technology facilitates healthcare without constraining it
- Patient safety is sustainable
- Patients and their families are engaged partners in patient safety
- Patient safety research is transdisciplinary

The WISH forum concludes that these themes are enablers to move healthcare from its current state into one where preventable harm is eliminated. Recognising the human factors leading to transfusion errors will move transfusion safety closer to the ultimate goal of eliminating preventable harm.

References

BCSH Harris A M, Atterbury CLJ et al. (2009) **BCSH Guidelines on the administration of blood components** http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf [Accessed 30/03/2015]

Bolton-Maggs PHB, Poles D et al. (2014) **2013 Annual SHOT Report** www.shotuk.org. [Accessed 30/03/2015]

Berwick D, National Advisory Group on the Safety of Patients in England. (2013) **A promise to learn – a commitment to act: improving the safety of patients in England**. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226703/Berwick_Report.pdf

Clinical Human Factors Group (2014) **First do no harm: closing the gap in patient safety**: 1-66 http://chfg.org/news/a-roadmap-for-further-embedding-human-factors-in-the-nhs [Accessed 30/03/2015]

Denham CR (2007) **Trust: the 5 rights of the second victim**. J Patient Saf 3, 107-119

Edrees J and Federico F (2015) **Supporting clinicians after medical error**. BMJ 350:h1982

Francis R. (2013) **Report of the Mid Staffordshire NHS Foundation Trust Public Enquiry**. http://www.midstaffspublicinquiry.com/

Hollnagel E (2014) **Safety-I and Safety–II: The Past and Future of Safety Management**. Ashgate Publishing, Ltd.

Medically Induced Trauma Support Services (2010) **Clinician support toolkit for healthcare 2010**. www.mitsstools.org/tool-kit-for-staff-support-for-healthcare-organizations.html [Accessed 23/04/2015]

NHS England, N. (2013) **Human factors in healthcare - a concordat from the National Quality Board**. http://www.england.nhs.uk/wp-content/uploads/2013/11/nqb-hum-fact-concord.pdf . 1-22. [Accessed 30/03/2015]

NICE (2011) **Hip Fracture: The management of hip fracture in adults**. https://www.nice.org.uk/guidance/cg124/ [Accessed 23/04/2015]

Pronovost PJ, Ravitz AD et al. (2015) **Report of the WISH Patient Safety Forum, Transforming Patient Safety: A Sector-Wide Systems Approach** http://wish.org.qa/summit/2015-summit/reports-en/patient-safety-en [Accessed 30/03/2015]

9 Incorrect Blood Component Transfused (IBCT) (clinical and laboratory errors) n=278

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The category of incorrect blood component transfused is divided into instances where a wrong component was transfused (WCT) and those where the specific requirements were not met (SRNM).

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).

Key SHOT messages

WCT: ABO-incompatible red cell transfusions:

- In 2014 there were 10 ABO-incompatible red cell transfusions all caused by clinical errors in both collection and administration, or administration alone. These numbers exclude ABO errors in haemopoietic stem cell transplants (HSCT). Eight recipients were group O, and 6 of these received group A units. One experienced major morbidity and there were no deaths. These indicate that staff are not following procedure and are putting patient lives at risk

WCT: Overall:

- Patient identification failure as a result of incomplete checking was the root cause in 17/40 clinical wrong component transfusions. This is a fundamental element in the transfusion process and the point at which a wrong transfusion can be prevented (BCSH Harris et al. 2009)
- Component selection errors in the laboratory may be due to lack of understanding, knowledge and skills by laboratory staff, but correct storage can prevent the wrong component being selected by laboratory staff e.g. cryoprecipitate stored in the incorrect drawer and mistakenly issued as fresh frozen plasma (FFP)

SRNM:

- Failures to communicate the patient's specific requirements continue to be the leading cause of patients not receiving components of the correct specification for them
- The relevant British Committee for Standards in Haematology (BCSH) guidelines (e.g. BCSH Treleaven et al. 2011, BCSH Gibson et al. 2004) are clear regarding specific requirements for blood transfusion. It can be particularly difficult when the patient is treated in an area where staff may not be familiar with the patient groups who may have specific requirements. Transfusion is a small part of medical and nursing practice accordingly, clear communication in handover and in the case notes is essential to alert colleagues to the patient's needs

Analysis of multiple errors:

- Many IBCT incidents demonstrate multiple errors in the process (median number of errors 3). The individual steps in the transfusion process incorporate independent checks at each stage which are designed to confirm the details and so should detect earlier errors (BCSH Harris et al. 2009)
- The pre-administration bedside check is a fundamental step as it is the final opportunity to detect an error earlier in the process and prevent a wrong transfusion. In 2014 162/265 (61.1%) of cases analysed could have been detected at this point

Summary data

A total of 278 reports were received where patients received an incorrect blood component.

In 202/278 (72.7%) patients received units where the specific requirements were not met (Table 9.1). Patient ages ranged from birth to 101 years (median 61).

Twenty nine cases were reported in children:

- 12 laboratory errors, 4 WCT and 8 SRNM
- 17 clinical errors, 8 WCT of which one was a haemopoietic stem cell transplant (HSCT) and 9 SRNM

For further information about paediatric and transplant cases please see Chapter 20 Paediatric Cases and Chapter 22 Summary of Incidents Related to Transplant Cases.

Table 9.1: An overview of incorrect blood components transfused n=278

Type of event	Clinical	Laboratory
Wrong blood	**18**	**14**
ABO-incompatible red cells*	*10*	*0*
D-mismatched red cells	*0*	*8*
Compatible red cell groups but not intended for that patient	*8*	*6*
Others	**14**	**15**
ABO identical platelets**	*0*	*1*
D-mismatched platelets transfused	*0*	*3*
Wrong component type transfused (compatible)	*11*	*7*
ABO non-identical fresh frozen plasma (FFP)	*1*	*3*
Least incompatible red cells selected following serological crossmatch	*0*	*1*
Patient with atypical red cell antibodies received incompatible emergency O D-negative red cells; the component was intended for another patient	*1*	*0*
Mother's crossmatched red cells given to neonate at delivery	*1*	*0*
Wrong group selected for HSCT/solid organ transplant patients	**8**	**7**
Wrong ABO group	*7*	*4*
Wrong D group	*1*	*3*
Specific requirements not met	**116**	**86**
Total	**156**	**122**

** In one case the red cells were also D mismatched*

*** in this case 2 platelet packs were issued to 2 different patients but were labelled and issued the wrong way round*

Deaths n=0

There were no deaths reported as a result of an incorrect blood component being transfused.

Major morbidity n=4 (3 laboratory and 1 clinical case)

One of the 10 patients who received an ABO-incompatible red cell transfusion suffered major morbidity, Case 1. In 3 other cases laboratory errors resulted in K-sensitisation in women of childbearing potential.

Case 1: Component collection and administration error leads to ABO-incompatible transfusion requiring haemodialysis

Red cell units were taken in advance to the operating theatre and placed in one of the blood refrigerators. A member of staff went to the blood refrigerator without patient identifiers to collect units for the patient (group O) in theatre. The incorrect unit was collected without formal checking and the two staff administering the red cells (group A) did not do any checks at the patient's side prior to administration. The error was only realised at the end of the surgery. The patient required haemodialysis.

Potential for major morbidity n=7

There were 7 cases due to laboratory errors.

- In 4 instances D-positive red cells were transfused to D-negative women of childbearing potential (mixture of testing and component selection errors)
- In 3 cases K-positive units were transfused to women of childbearing potential (all component selection errors)

Case 2: A biomedical scientist (BMS) overrides warning flag while rushing during a late shift

A group B D-negative female neonate (premature 24/40) was transfused 10.5mL of O D-positive red cells. This error was detected 9 days after the transfusion. The laboratory information management system (LIMS) showed a warning flag during the component issue but this was overridden by the BMS working a late shift when they were rushing to complete the work. Also the component label was not checked when attaching it to the red cell pack. Other errors occurred during the collection from the refrigerator and the final bedside administration check, a total of 4 errors.

Learning point

- There should always be staff of sufficient competence to perform the workload in the transfusion laboratory. The UK Transfusion Laboratory Collaborative Standards (2014) clearly outline staffing, information technology and knowledge and skill requirements of transfusion laboratories (Chaffe et al. 2014)

ABO-incompatible red cell transfusions n=10

(All clinical errors)

There were 10 ABO-incompatible red cell transfusions (Table 9.2). One of these was also a D mismatch. In 3 cases the error was discovered when the patient experienced a mild-moderate reaction but in one case a more serious reaction occurred with renal failure requiring dialysis (Case 1 above).

Note:The EU requires reporting of 'immunological haemolysis due to ABO incompatibility' however, those cases where an ABO-incompatible transfusion has taken place without evidence of haemolysis are currently not reportable (which are 66% of all cases as illustrated in the Annual SHOT Report for last year). There was evidence of haemolysis in only 4/10 cases.

Error	Patient group	Group of red cell unit
Collection and administration	O+	A+
Collection and administration	O+	A+
Collection and administration	O+	A+
Collection and administration	A+	B+
Collection and administration	O+	A+
Administration	O+	B-
Administration	O+	A+
Administration	O+	A+
Administration	B+	A+
Administration*	O-	AB+

**also D mismatch*

Table 9.2: ABO-incompatible red cell transfusions 2014 n=10

Case 3: Medical review following a transfusion reaction reveals transfusion was to the wrong patient

Two patients in adjacent beds required blood transfusions. A collection slip was completed and handed to the porter. Patient S (group O D-positive) was the intended recipient however; the collection slip was incorrectly completed with Patient W's details (group A D-positive).

The error was not detected at the bedside as nursing staff failed to complete bedside checks. Three minutes into the transfusion, the patient became breathless, the transfusion was stopped and the medical team called. The doctor noted that the blood unit was labelled with different patient details. Patient S had received 15mL of an ABO-incompatible transfusion (group A red cells transfused to a group O recipient). The patient was admitted to the high dependency unit (HDU) as a result of his co-morbidities but had no long term complications from the incident.

D mismatches n=11

There were 11 cases, all laboratory errors, (9 female, 1 male and 1 gender unknown) where D-mismatched components were erroneously transfused, (8 red cells and 3 platelets). Four of these 11 cases are described earlier as they had the potential for sensitisation in women of childbearing potential. In 4 cases the wrong D group was given to a male patient or females who were not of childbearing potential. An additional 3 transfusions occurred where the patient received platelets of the wrong D group due to a component selection error. There are occasions when there is a considered decision to transfuse non-identical components to patients, however in all these cases the transfusions were due to error. The risk of developing anti-D as a result of receiving D-positive platelets is much lower than for red cells. The platelet membrane does not express D and the risk is attributable to the accompanying red cells. A recent study of 485 D-negative recipients who had received D-positive platelets found that 7/485 (1.4%) developed anti-D (Cid et al. 2015).

Causes of error:

- Six testing errors (4 D grouping errors, 2 procedural errors)
- Five component selection errors

Case 4: Failure to correctly determine D status of patient leads to transfusion of several group O D-positive red cell units

In 2011 a young woman was grouped as O weak D but the result was edited on the LIMS as O D-positive. The sample was not sent to the Blood Service for further investigation. She presented again in February 2014 and again grouped as O weak D and was transfused 3 units of O D-positive red cells. She was admitted to another hospital in October 2014 and was grouped as O weak D, and this time the sample was referred to the Blood Service who reported a D variant (DAR). The patient should therefore be regarded as D-negative for transfusion purposes. She did not develop anti-D.

Learning point

- The standard operating procedures (SOP) should be clear and prescriptive in the process for determination of the D type of a patient with clear information about which D group to transfuse, aligned to national guidelines and recommendations (BCSH Milkins et al. 2013)

Wrong component type transfused n=18

In 18 cases an incorrect component type was requested, issued or administered to the patient. In 7/18 cases the error originated in the laboratory; 4/7 of these could have been detected by the final bedside administration checks.

It is surprising that staff who should have been trained and competency-assessed for participation in transfusion practice still do not recognise differences in component types despite their different appearances and storage locations.

Table 9.3: Laboratory causes of wrong component type transfused n=7

Urgency	Required	Issued then administered
Routine	Prothrombin complex concentrate (PCC)	Platelets
Routine	Patient X received HLA-matched platelets issued and labelled for patient Y	
Emergency* n=2	Group-specific red cells	O D-negative red cells
Routine	Transposition of labels (Pack 1 and Pack 2) for platelets from the same donation intended for 2 separate patients	
Routine	FFP	Cryoprecipitate
Urgent	FFP	Cryoprecipitate

** In these 2 cases the patient had atypical antibodies and the emergency O D-negative units of red cells were incompatible with the recipients*

Urgency	Required	Administered	Collected by	Administered by
Urgent	Neonatal emergency red cells	Adult emergency red cells	Unknown	Unknown
Emergency	Neonatal emergency red cells	Adult emergency red cells	Nurse	Unknown
Urgent	Red cells	Platelets	Unknown	2 nurses
Urgent	Platelets	Red cells	HCA	1 nurse
Urgent	Platelets	FFP	HCA	2 nurses
Urgent	Platelets	FFP	HCA	1 midwife & 1 nurse
Routine	Platelets	FFP	Porter	2 nurses
Routine	FFP	Red cells	HCA	2 nurses
Routine	FFP	Red cells	HCA	1 nurse
Routine	FFP	Red cells	Nurse	1 nurse
Emergency	**FFP	Platelets	N/A	1 nurse

Table 9.4: Clinical errors resulting in wrong component type transfused n=11

Nurse=registered nurse, HCA=health care assistant

Two of the cases (clinical errors) resulted in neonates receiving emergency adult red cells instead of the emergency units of neonatal specification. In one of the other cases in this group, FFP instead of platelets was transfused in an emergency and this component was part of a trauma pack**. The nurse administered FFP in error when platelets were prescribed. She proceeded to sign for the FFP against the platelet prescription.

ABO non-identical FFP transfusions n=4

There were 3 non-identical FFP transfusions resulting from 1 grouping error and 2 cases where the wrong component was selected, all were emergencies or urgent, (Case 5). In 1 further case, there was confusion when the doctor prescribed FFP for patient X but requested FFP for patient Y. The two nurses checked the prescription chart but did not check the compatibility tags on the unit of FFP resulting in patient X (group AB D-positive) receiving FFP issued and labelled for patient Y (group O D-positive).

Case 5: Issue of inappropriate group ABO FFP in an emergency

Following admission of a trauma patient with haemorrhagic shock the massive haemorrhage protocol was activated. Three units of group O FFP thawed for a previous patient were available. These 3 units were allocated and transfused to the trauma patient. The patient's correct group was A. This error was noticed during fating of the units. This work was performed out-of-hours by a BMS who did not normally work in the transfusion laboratory. The laboratory SOP was also not clear concerning the ABO compatibility requirements of FFP.

Learning point

- All members of staff working in a blood transfusion laboratory must actively and regularly participate in a programme of practical and knowledge-based competency. Staff who are not permanently established in blood transfusion should complete at least 10 days of supervised working with the transfusion laboratory (Chaffe et al. 2014)

Wrong group selected for HSCT/solid organ transplant patients n=15 (8 clinical and 7 laboratory errors)

In 8 clinical cases (7 ABO and 1 D) the main causes were poor communication between clinical and laboratory staff or poor communication between hospitals in shared cases. In addition, there were 7 cases where the laboratory issued the wrong/unsuitable group to HSCT patients (4 ABO and 3 D).

In 1 of these cases, a patient had the wrong group FFP selected following an incompatible organ transplant. These are discussed in Chapter 22 Summary of Incidents Related to Transplant Cases.

Near miss WCT cases n=795

Table 9.5: Near misses that could have led to IBCT n=795

Point in the process	Type of error made	Number of cases	Percentage of cases
Request	Request for incorrect patient	4	1.0%
	HSCT group error when requesting	3	
	Wrong component requested	1	
Sample taking	Wrong blood in tube (WBIT)*	684	86.0%
Sample receipt	Entered into incorrect patient record	13	1.8%
	Incorrect patient administration system (PAS)/ LIMS merge	1	
Testing	Misinterpretation	4	2.6%
	Incomplete testing prior to issue	2	
	Manual group error	4	
	Transcription	6	
	ABO testing error (cause unknown)	5	
Component selection	D-positive issued to D-negative patient	7	2.1%
	Incorrect component type	7	
	Wrong ABO group selected	3	
Component labelling	Transposition labels between patients	2	0.8%
	Component mislabelled	4	
Collection	Collection incorrect unit	33	4.4%
	Wrong details on collection slip	1	
	Wrong units sent to ward	1	
Administration	Attempted administration to the wrong patient	10	1.3%
Total		**795**	**100%**

** 2 other WBIT incidents could have led to avoidable transfusions and are included in Chapter 10 Avoidable, Delayed or Undertransfusion (ADU)*

WBIT potentially leading to IBCT n=684 (+2 ADU=686 WBITs in total)

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

For the second year (2013 and 2014) there were no reports of WBIT resulting in an incorrect transfusion, but the number of reported near miss WBITs remains high. This is a good illustration of the value of near miss reports as it indicates persistence of dangerous practice and continued need for improvement.

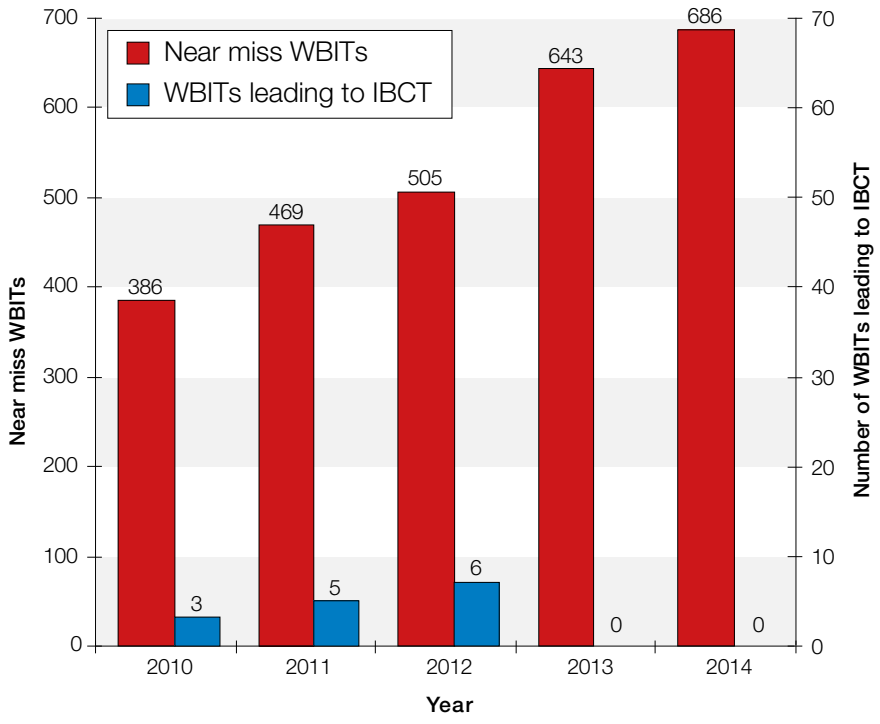


Figure 9.1: Cumulative comparison of total near miss WBIT reports and those leading to IBCT 2010-2014

Detection of WBIT incidents that could have led to IBCT n=684

Point in the process	How was WBIT error detected	Number of cases	Percentage of cases
Sample receipt	Sample taker realised error	63	15.8%
	Detected by laboratory vigilance	38	
	Alerted by a non-transfusion sample	7	
Testing	At authorisation of results	239	77.3%
	Unknown point during testing	238	
	Further sample differed	37	
	Alerted by a non-transfusion sample	15	
Administration	Other colleague realised error	25	6.6%
	Sample taker realised error	18	
	Pre-administration checks	2	
Other	Patient realised	2	0.3%
Total		**684**	**100%**

Table 9.6: Point in process where wrong blood in tube incident was detected

Laboratory processes are particularly important in detecting WBIT, but patient safety relies on quality processes and checks undertaken by all staff involved in transfusion, both laboratory and clinical. An improved safety measure was introduced in the 2012 BCSH guidelines for pre-transfusion compatibility procedures (BCSH Milkins et al. 2013) which recommends a group-check sample should be tested for all patients where there is no historical group and group O red cells should be used until a second confirmatory group is established. It may be advantageous to consider taking an initial grouping sample and second confirmatory sample from any patient who may require transfusion at some point.

Case 6: Undertaking a group-check sample may prevent patient harm

Five years previously, a patient had been bled for a number of tests as part of a pre-surgical assessment. That was the patient's first group and save and the result would have been used as the historical sample for future transfusion-related requests. A second sample at the time was haemolysed and therefore not processed, so no check group was done. During the intervening years the patient attended hospital for four more inpatient admissions and a group and antibody screen was not repeated at any time. On the fifth admission, five years after the original grouping sample, a second group and antibody screen sample was taken. The first sample had shown the group to be O D-positive, but the sample five years later was B D-positive. A repeat sample confirmed the patient was B D-positive. As well as the original wrong blood in tube grouping error, this patient was also cleared for the initial procedure with blood tests belonging to another person.

Further details of cases related to wrong blood in tube and an analysis of the group check sample policy are included in Chapter 7 Near Miss Reporting (NM).

Information technology (IT)-related IBCT-WCT cases n=22

There were 22 IBCT-WCT cases that also had an IT element and these are described below. The numbers are included in the tables above where appropriate, so these are not additional cases.

Use of warning flags or alerts n=15 and failure to consult the historical record n=1

There were 9 cases where a warning flag was in place but not heeded, 6 where the flag was not updated and 1 where the historical record was not consulted.

Ten of these 'wrong blood' incidents were in haemopoietic stem cell transplant patients and two in renal transplant patients. Wrong blood errors in transplant centres may arise because of the complexity of information stored on the LIMS. In some situations the LIMS did not appear to have the functionality to manage the changing requirements before, during and after a transplant. The key elements requiring some IT control include the ability to

- Flag the date of the haemopoietic stem cell or solid organ transplant
- Store the recipient and donor blood groups as well as the current blood group
- Support the issue of each blood component of the correct group

There were also errors related to poor communication between the clinical area and the laboratory either in terms of the timeliness of the information about the transplant or where care was shared between a transplant centre and a local hospital. Therefore the laboratory was unable to update warning flags.

Incorrect result entered manually n=4

All four cases had an anomalous D group that required investigation and had a wrong D type recorded on the LIMS. The cases highlight problems that can arise either with manual editing of the initial result or transcribing the red cell reference laboratory result incorrectly.

Online blood ordering system (OBOS) n=1

Case 7: Potential sensitisation to D due to a 'tick-box' error

OBOS was used to order emergency platelets for a woman of childbearing potential with gastrointestinal (GI) bleeding. The BMS ticked the wrong box and ordered A D-positive platelets but the patient was A D-negative. A different BMS issued the platelets as soon as they arrived and failed to notice the D mismatch. The woman received anti-D immunoglobulin to prevent sensitisation.

Electronic blood management systems n=1

Case 8: Wrong blood collected despite a visual and audible alarm

Blood was removed from an issue refrigerator using an electronic blood management system and the operator did not heed the alarm warning that the wrong blood was being collected. The blood was transfused to the wrong patient but was ABO compatible.

Specific requirements not met (SRNM)

Type of specific requirement	Number of laboratory cases	Number of clinical cases	Total
Irradiated units	14	102	**116**
Specific phenotype of red cells	41	4	**45**
Inappropriate use of electronic issue (EI)	11	0	**11**
K-negative units for females of childbearing potential	6	0	**6**
Pathogen-inactivated FFP or cryoprecipitate	6	0	**6**
Cytomegalovirus (CMV) negative units	1	4	**5**
Components issued based on 1 sample only and no confirmatory blood group check taken	4	0	**4**
HLA-matched platelets	1	1	**2**
Blood warmer required	0	3	**3**
Human platelet antigen (HPA)1a-matched platelets	1	1	**2**
Platelets in platelet additive solution	0	1	**1**
Washed red cells	1	0	**1**
Total	**86**	**116**	**202**

Table 9.7: Specific requirements not met n=202

The total number of incidents where specific requirements were not met that were reported in 2014 in the laboratory (86 reports) has increased compared with 2013 (56 reports).

The most commonly reported laboratory errors have increased compared to 2013. These are:

- Failure to provide specifically phenotyped (25 in 2013 compared with 41 in 2014)
- Failure to provide irradiated units (8 in 2013 compared with 14 in 2014)
- Inappropriate use of electronic issue (5 in 2013 compared with 11 in 2014)

The number of cases due to clinical errors has reduced from 134 (2013) to 116 (2014)

Failure to provide irradiated components n=116

This was the most common unmet specific requirement (116/202, 57.4%),

- 14/86 (16.3%) of laboratory reports
- 102/116 (87.9%) of clinical reports

These failures were usually in patients where the indications were either previous treatment with a purine analogue or a history of Hodgkin lymphoma (BCSH Treleaven et al. 2010).

Case 9: Wrong patient identification (ID) number and failure to check for multiple records results in non-irradiated components being supplied to a patient previously treated with fludarabine

A request form was received by the transfusion laboratory requesting blood for a patient the following day. No clinical details or specific requirements were noted on the form. The laboratory entered the request onto the LIMS but failed to check for previous records for this patient. Blood was crossmatched and subsequently transfused. However, the patient had a second record with a different hospital number which recorded the requirement for irradiated components due to previous treatment with fludarabine (purine analogue). This was not picked up by the transfusion laboratory or the staff on the day unit transfusing the blood.

This happened again when the same hospital number was used as on the original request. Both request forms had been completed by the same non-clinical member of staff who was not qualified to request blood. The crossmatches were performed on two sites by different people.

In the 14 laboratory cases:

- 6/14 cases the BMS failed to consult available patient historical records
- 6/14 the BMS missed information that was provided on the request form
- 2/14 patient demographics or LIMS flag was incorrectly transcribed

Inappropriate use of electronic issue n=11 of 86 laboratory cases

- 9/11 BMS failed to exclude these patients from electronic issue
- 2/11 the use of electronic issue could have been avoided if laboratory staff had heeded previous transfusion history

Case 10: Failure to merge patient records from a previous computer system resulted in the antibody history being inaccurate and patient receiving incorrectly phenotyped units

A sample was received from a patient with a history of anti-E documented on a previous computer system. However, this information was not present on the current LIMS. The antibody was not detected by the antibody screen and the BMS took no account of the patient history. An unselected unit of red cells was allowed to be issued on the current LIMS that was later identified to be E-positive.

Learning point

- Laboratory staff must take care when using legacy systems to ensure that all data affecting patient safety is migrated to replacement systems. The British Committee for Standards in Haematology (BCSH) Guidelines for the specification, implementation and management of information technology (IT) systems in hospital transfusion laboratories (BCSH Jones et al. 2014) state *'Retaining operational data on a legacy system that is not electronically linked to the operational system (i.e. interrogating a separate database which is a manual step), is not acceptable for maintaining patient safety within the transfusion laboratory.'*

Incorrect phenotype n=45 (41 laboratory and 4 clinical errors)

In 41 cases laboratory staff issued incorrectly phenotyped units to patients; 2 resulted in sensitisation, one patient developed anti-E and another experienced haemolysis as anti-c was missed during pre-transfusion testing.

In summary:

- 19 testing errors (18 procedural errors and 1 interpretation error)
- 15 sample receipt and registration errors (in 14 the patient's historical records were not consulted, and in 1 incorrect patient demographics were entered)
- 6 component selection errors
- In 1 case the Blood Service red cell immunohaematology (RCI) laboratory supplied an incomplete report that did not record the phenotype of the patient

Additional testing and sample receipt and registration errors are discussed in the laboratory chapter, Chapter 11 Summary of Events Originating in the hospital transfusion laboratory.

The other 4/45 cases resulted from clinical failures to inform the transfusion laboratory that the patient required phenotyped units.

- In two cases, the need for phenotyped units was not indicated on the request
- In one case the clinical staff associated the sample with an emergency department number so the flag for a known anti-Fy3 was missed because the historical record was not reviewed

- In one case, the patient showed the clinical staff an antibody card 4 days after the transfusion. The card had been issued 29 years previously from another Trust/Health Board

Case 11: A pregnant woman fails to receive CMV negative red cells

A pregnant woman (gestation 19 weeks) was having a liver transplant. The red cells requested and transfused were not CMV negative because the blood transfusion laboratory was unaware the patient was pregnant. The requestor did not select CMV negative or indicate that the patient was currently pregnant on the request form. This was discovered when documented on the second request form after the initial red cells had already been administered. There was no historical record in the transfusion laboratory for this patient.

This unusual case highlights the need for communication between the clinical and laboratory staff. It must never be assumed that the laboratory staff will know what the patient's requirements are and they should be confirmed by selecting the appropriate option on every request form. This includes obstetric patients who may be being treated in a non-obstetric location and particularly shared care patients who have been transferred from another hospital. Patients may have an alert card or know they need 'special blood' but it is not their responsibility alone. If there is any doubt, the requestor should contact the transfusion laboratory or the haematologist to discuss individual patient needs – time permitting.

Blood warmer not used for patients with cold agglutinin disease n=3

In three cases the prescription documented that the patient needed a blood warmer for red cell transfusion but this guidance was not followed. One of the patients in this group reported 'feeling shivery' during transfusion.

Near miss SRNM cases n=99

The near miss incidents relating 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	38.4%
	Insufficient information for phenotyping	6	
	Failure to request CMV negative	3	
Sample labelling	Incorrect labelling, so not linked to history	2	2.0%
Sample receipt	Failure to notice request for irradiated/CMV negative	29	29.3%
Testing	Incomplete testing prior to issue	9	12.1%
	Interpretation	2	
	Equipment failure	1	
Component selection	Failure to issue irradiated	6	17.2%
	Failure to issue correct red cell phenotype	11	
Component labelling	Component mislabelled	1	1.0%
Total		**99**	**100%**

Table 9.8: Near misses that could have led to IBCT-SRNM n=99

Information technology (IT)-related IBCT-SRNM cases n=128

There were 128 IBCT-SRNM cases that also had an IT element and these are described below. The numbers are included in the tables above where appropriate, so these are not additional cases. There were 49 laboratory errors, and 79 clinical errors.

Use of the historical computer record: laboratory n=18 and clinical n=15

In 18 laboratory cases the historical record was not consulted, or not linked to the current record, when selecting suitable blood components for transfusion.

- In 14 cases the blood selected was not of the correct phenotype either because the patient had historical antibodies but a negative antibody screen, or because there were other red cell antigens that should have been selected for
- In 4 cases non-irradiated blood components were issued because the historical record was not identified or merged

There were 15 clinical cases where the historical record was not consulted or linked to the current record. The primary error was in the request in 13, in 1 there was communication failure and 1 patient was registered under a different hospital number.

- 2/15 non-phenotyped blood selected for a patient in error
- 12/15 non-irradiated blood components were issued in error: 5 of these were shared care patients where the information was on a computer record but not the one available at the time of issue of the blood or platelets
- There was 1 clinical case where a woman was being transfused electively in pregnancy and non-CMV tested blood was transfused

Warning flags not in place, not heeded or not used laboratory n=27, clinical n=63

There were 10 cases where a warning flag was in place on the LIMS but was not heeded.

- 5/10 did not receive irradiated components
- 1/10 did not receive CMV negative components
- 2/10 did not receive the antigen-negative blood that was required
- 2/10 were given the right blood but were reported because procedures were not followed

In a further 16 cases a warning flag was not activated, or not updated with current information. In the following instances (13/16) this resulted in:

- 6/13 issue of non-irradiated components
- 1/13 did not receive HLA-matched platelets
- 4/13 antigen-negative requirements were not met
- 2/13 patients born after January 1st 1996 were not given MB-FFP because the flag was incorrectly set as <16 years and the patient was between 16 and 17 years

There were 64 cases where flags were not used but might have prevented errors had they been in place. Most of these were 50 clinical cases but in a further 5 laboratory cases flags could have been used to prevent the issue of non-irradiated components. On two occasions standard platelets were issued to patients that needed platelets resuspended in additive solution but fortunately there were no adverse reactions.

Incorrect Blood Component Transfused: Serial Errors and Multiple Missed Opportunities to Detect an Earlier Error

In 2013 SHOT analysed cases where an incorrect blood component was transfused (IBCT) to identify not only the primary error but also to see if there were further opportunities to detect the primary error later in the nine-step transfusion process. We have repeated this for 2014.

There has been an increase in IBCT reports in 2014 with 278 cases compared to 247 in 2013. The reports have been sub-divided into wrong component transfused or specific requirements not met. Table 9.9 shows the nine steps in the process and where the errors occurred.

Figure 9.2: A review of errors resulting in incorrect blood components transfused and missed opportunities for detection n=692 (278 reports)

In 13 reports (1 laboratory; 12 clinical) the errors could not be attributed to a missed step in the transfusion process but were due to communication failures e.g. shared care patients (between hospitals and failure to notify of haemopoietic stem cell transplant) and in one case between the reference laboratory and the hospital laboratory (Case 18).

Table 9.9: Comparison of primary error and missed opportunities for detection

Steps in the transfusion process	Number of cases by step of primary error	Missed opportunities to detect the primary error	Total steps in the process where an error was made or an opportunity was missed to detect the primary error
Request	108	0	108
Sample taking	0	0	0
Sample receipt	55	21	76
Testing	42	13	55
Component selection	21	91	112
Component labelling	3	8	11
Collection	23	5	28
Prescription	11	129	140
Administration	2	160	162
Total	**265 cases**	**427 missed opportunities**	**692 errors**

Missed opportunities to detect the primary error

Multiple errors in the transfusion process are common (median number 3, Figure 9.3). A review of the steps indicates how and when some of these errors could have been identified at different critical points in the transfusion process.

Figure 9.3: Number of steps with errors in each transfusion: n=265 reports

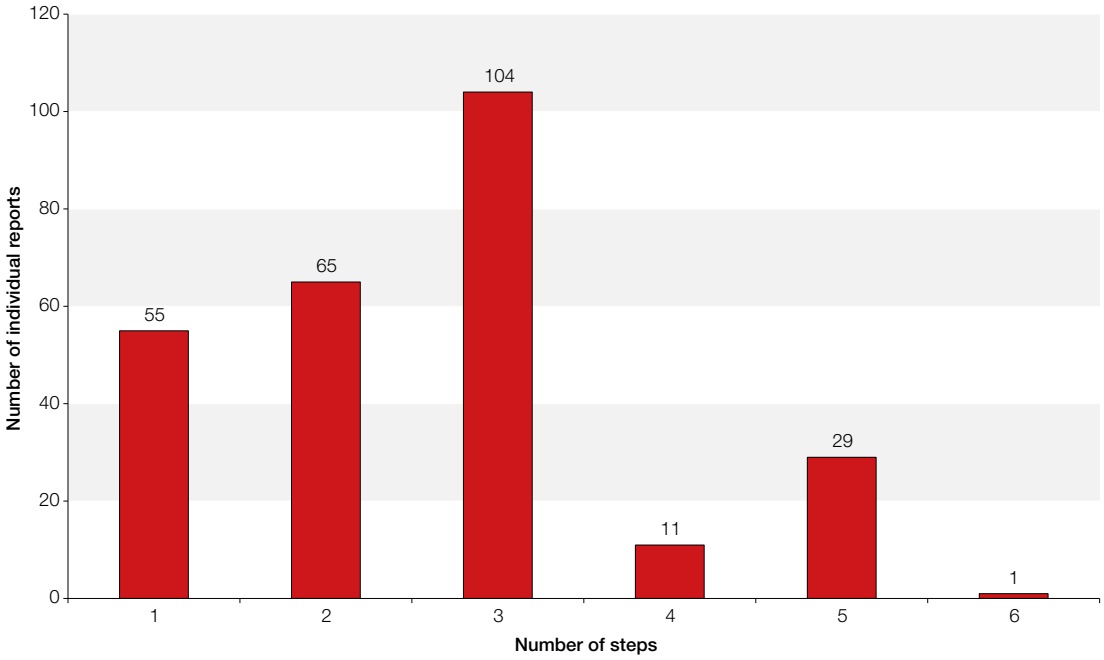
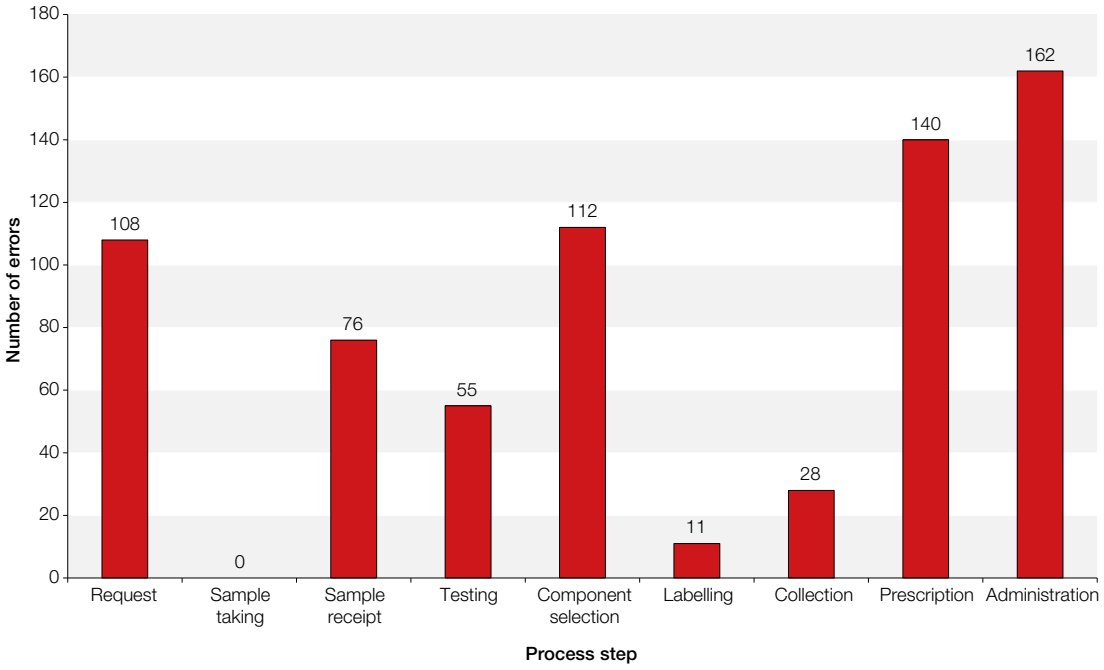


Figure 9.4: Steps in the process where an error was made or an opportunity was missed to detect the primary error n=692



Six steps: A case where there were 5 opportunities to detect the primary error n=1

The primary error occurred in the laboratory at sample receipt and registration and was followed by a further 5 opportunities to detect the error; at component selection, component labelling, collection, prescription, and administration.

Case 12: The biomedical scientist (BMS) did not heed the request and selected the wrong component

A request for 4 units of solvent-detergent fresh frozen plasma (SD-FFP) was received for a patient with a bleeding disorder. The initial request for FFP was made by telephone and the BMS started thawing standard FFP. The request form arrived and the BMS failed to notice that SD-FFP had been requested and continued to issue and label the thawed FFP.

1. **Primary error: Request**: The initial telephone request failed to identify the correct component required
2. **Component selection**: The component was not selected based upon the request form which clearly indicated the component required
3. **Component labelling**: A final check during component labelling failed to cross-check the request form
4. **Collection**: the collector did not check that they had collected the right component
5. **Prescription**: The requirement for SD-FFP was not specified on the prescription chart to prompt the person performing the bedside check
6. **Administration**: The final bedside check failed to identify the right component was to be transfused

Five steps: Cases where 4 opportunities for detection followed the primary error n=29

- In 21 cases the primary error at the point of request was followed by a further 4 missed opportunities to detect the error. All 21 cases resulted in specific requirements not being met with the same combination of primary error and opportunities for detection
- In 8 cases the primary error occurred in the laboratory, and 3 of these resulted in a wrong component being transfused

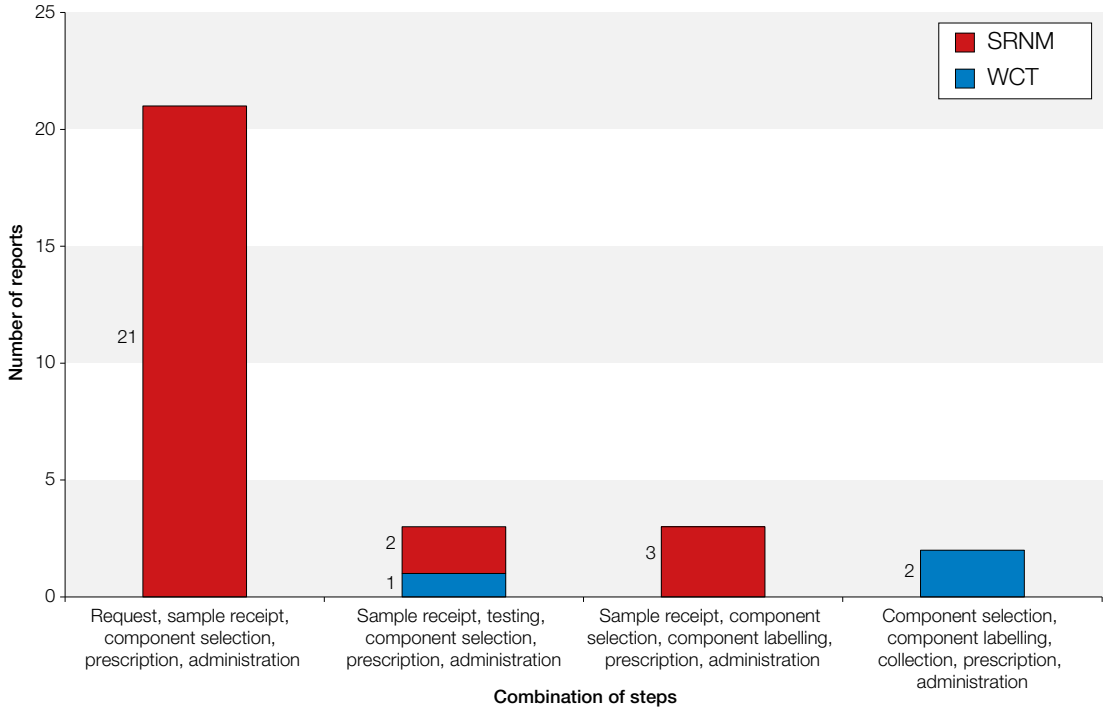


Figure 9.5: Combinations of primary and opportunities for detection: 5 steps n=29

WCT=wrong component transfused SRNM=specific requirements not met

Case 13: A patient was transfused non-irradiated red cells following mistakes in both the clinical and laboratory areas

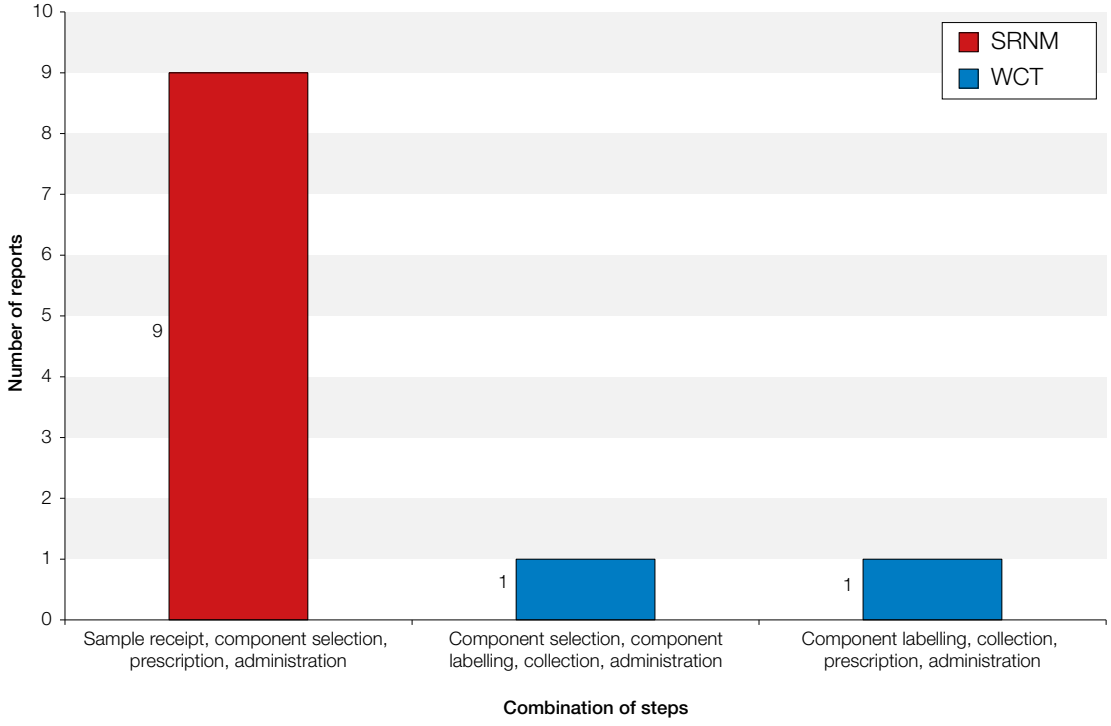
An 83 year old man required an urgent red cell transfusion. He had a past medical history of chronic lymphocytic leukaemia and had been admitted to the emergency department with possible neutropenic sepsis. Irradiated blood components had not been requested and the transfusion laboratory staff did not check patient details on the old laboratory information management system (LIMS). The new LIMS had not been updated to indicate that irradiated components were required. Three units of non-irradiated red cells were issued and transfused.

1. **Primary error: Request**: The need for irradiated components was not documented on the request form
2. **Sample receipt and registration**: The need for irradiated components was recorded on the old LIMS but had not been transferred to the new LIMS – this was missed by the BMS
3. **Component selection**: The specific requirement was not considered when the units of red cells were selected
4. **Prescription**: The need for irradiated components was not recorded on the prescription chart to prompt the person administering the blood that the patient had specific requirements
5. **Administration**: The need for irradiated components was not detected prior to administration and non-irradiated components were transfused

Four steps: Cases where there were 3 opportunities to detect the primary error n=11

In all these 11 cases the first error occurred in the laboratory (Figure 9.6), and could have been identified at several later steps in the clinical area, i.e. collection, prescription, final bedside check.

Figure 9.6: Combinations of primary error and opportunities for detection: 4 steps n=11



Case 14: Failure to heed available information on the LIMS

Red cells were requested for a haemopoietic stem cell transplant (HSCT) patient who required irradiated components. The BMS failed to follow the instructions on the LIMS to issue irradiated components. The LIMS did not control the selection of special requirement components and allowed the issue of non-irradiated red cells.

1. **Primary error: Sample receipt and registration**: The requirement for irradiated components was documented on the request form but missed by the BMS at the sample receipt and registration stage
2. **Component selection**: The specific requirement was not considered when red cell units were selected and the LIMS flag was ignored
3. **Prescription**: The need for irradiated components was not recorded on the prescription chart to prompt the person administering the blood that the patient had specific requirements
4. **Administration**: The need for irradiated components was not detected at the bedside check and non-irradiated components were transfused

Three steps: Cases where there were 2 opportunities to detect the primary error n=104

This is the largest group with the majority, 89/104, (85.6%) initiated by clinical errors.

- 72/104 (69.2%) were linked to the failure to provide irradiated components
- In 15/104 cases the primary error occurred in the laboratory, resulting in in 2 cases of wrong component transfused (1 where a woman of childbearing potential received D-mismatched platelets without anti-D Ig risking D-sensitisation, and in the other red cells of the wrong ABO group were given to an HSCT patient)

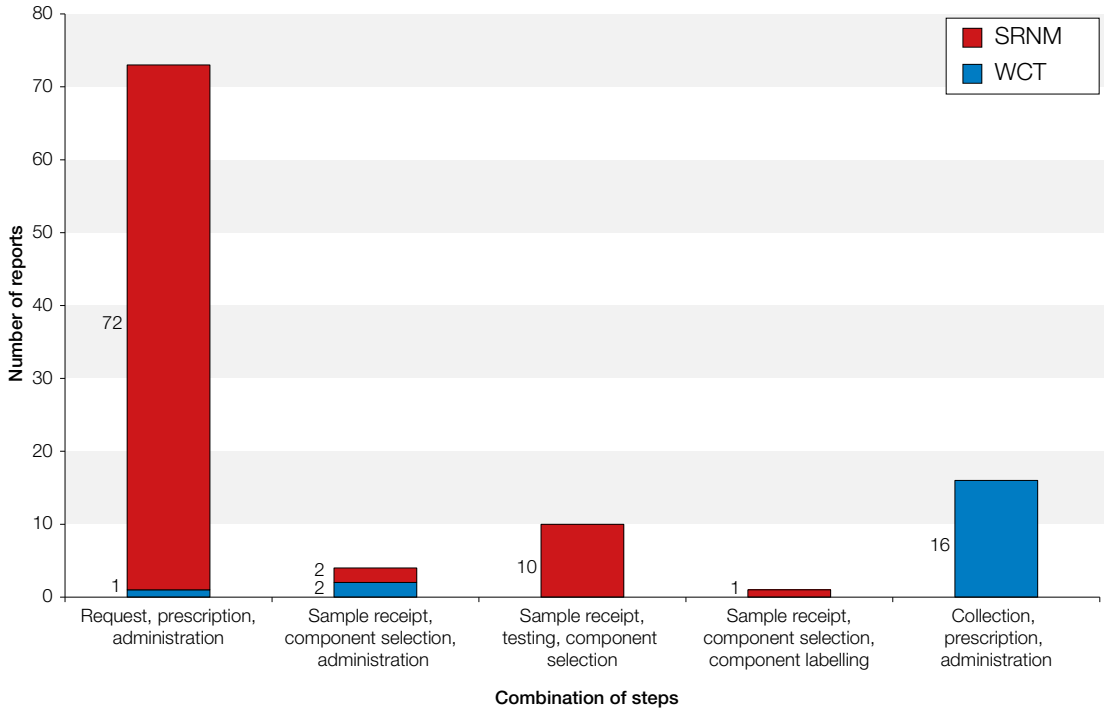


Figure 9.7: Combinations of primary error and opportunities for detection: 3 steps n=104

Case 15: Component collection error (platelets) leads to incorrect component type being documented as transfused (red cells)

A 65 year old man was admitted to the ward from the day unit following a transfusion of platelets at 17:12. The documentation showed that a bag of platelets had been recorded against the prescription for red cells meaning that the patient had received the wrong component. The patient then received another unit of platelets at 21:30 as prescribed because the staff were not aware that the platelets had been administered earlier in error. The patient received 2 units of platelets but only one had been prescribed.

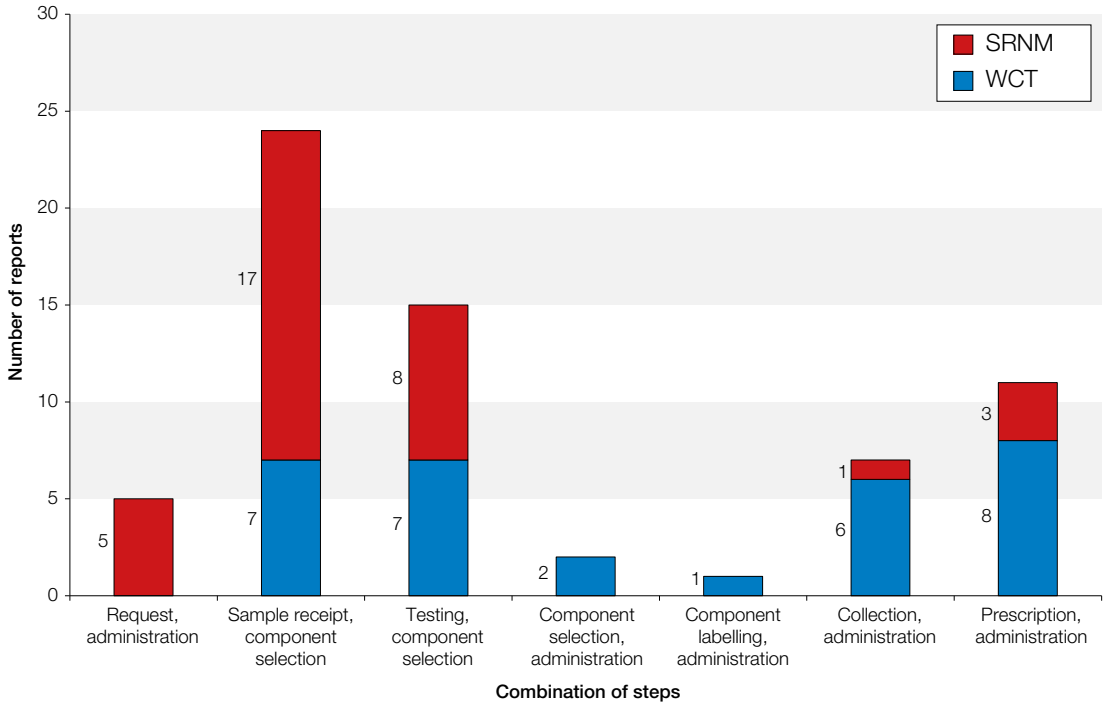
1. **Primary error: Collection**: The incorrect component type was collected from the laboratory – platelets instead of red cells
2. **Prescription**: The prescription was signed against the red cells
3. **Administration**: The collection error was not detected during the final check bedside check

Two steps: Cases with a single opportunity to detect the primary error n=65

In 42/65 (64.6%) cases the primary error occurred in the laboratory, in sample receipt, testing, component selection or component labelling.

- In 25/42 cases (59.5%) the patient received units of the incorrect specification and only 3 of these could have been detected at the final bedside check
- In 39/42 cases (92.9%) the primary error occurred in the laboratory at either the sample receipt or testing stage that could have been detected at the component selection stage by laboratory staff but was missed

Figure 9.8: Combinations of primary error and opportunities for detection: 2 steps n=65



Case 16: Misunderstanding of test results with selection of wrong Rh type

An urgent request for 2 units of red cells was received for a female patient. This was the first time this patient was tested. The D group showed a weak result against the anti-D with a negative control. The BMS then selected 2 units of O D-positive red cells instead of O D-negative red cells. The sample was sent to a reference laboratory for confirmation of the D group.

1. Primary error: Testing: The testing was incomplete having a an unconfirmed weak D result

2. Component selection: Selected D-positive instead of D-negative units

Single opportunity to prevent a wrong transfusion n=55

In 55/265 (20.8%) reports, a single error was made that could not have been detected later in the transfusion process. These occurred at different stages shown in Figure 9.9. Laboratory errors were responsible for 44/55 (80.0%) of these cases and are discussed in more detail in Chapter 11 Summary of Events Originating in the hospital transfusion laboratory.

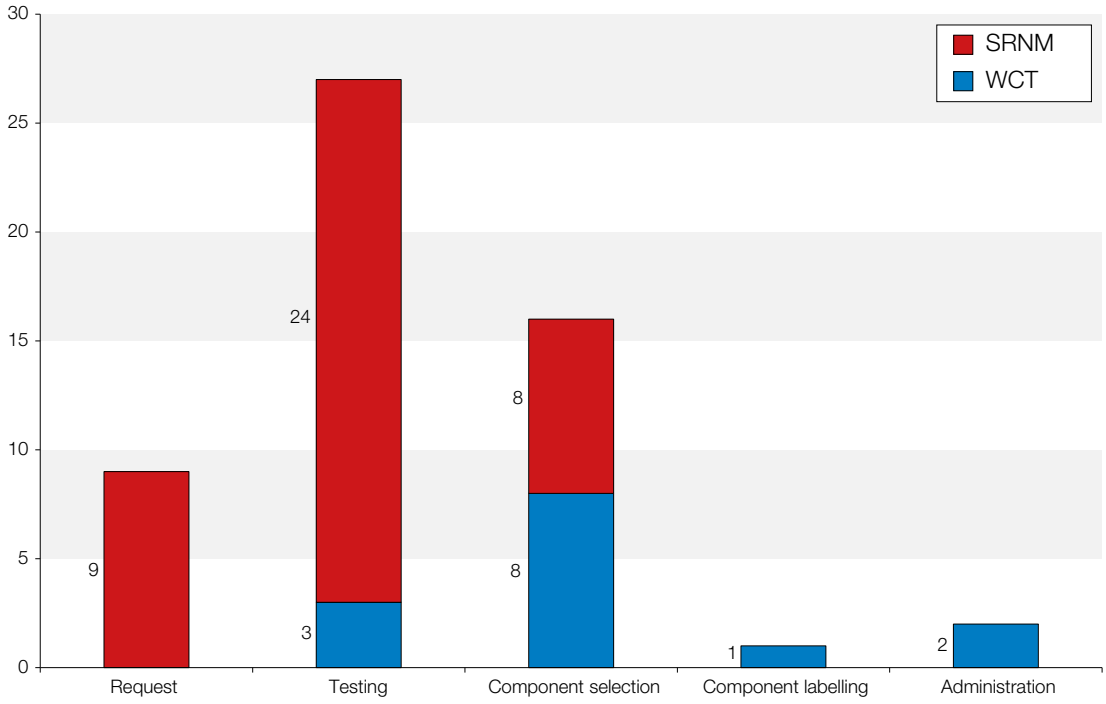


Figure 9.9: Primary errors with no further opportunities for detection: 1 step n=55

Case 17: Patients with sickle cell disease should be phenotyped prior to transfusion and receive Rh- and K-typed units

A child with sickle cell disease received 2 units of red cells that were compatible but not phenotype-matched, and a further 2 units 6 years later, again not phenotype-matched. Six months later following a further request it was noted that the patient had developed anti-C. Further testing identified the patient as C-negative (R_0r=cDe/cde) and that she had initially been transfused a C-positive unit. The BMS had failed to follow the standard operating procedure (SOP) to have a phenotype performed in the first instance prior to red cell issue.

1. **Primary error: Component selection** Phenotype-matched red cells should have been selected for issue

Other cases where errors occurred outside the steps of the transfusion process n=13

These cases were due to issues outside of the process described in Table 9.9 for example problems with communication in shared care cases and failure to forward transplant protocols to the laboratory.

Case 18: Incomplete information transmitted from the Blood Service: Communication failure

A reference laboratory issued an incomplete Rh-phenotype report when reporting an anti-Jk^a. The error was compounded by the transfusion laboratory staff who failed to fully transcribe the reported results into the LIMS. The patient then subsequently developed an anti-E following transfusion of Rh-unselected, Jk^a-negative red cells. The reference laboratory has now standardised the reporting of results.

Case 19: Failure to communicate the patient-specific requirement protocol to the transfusion laboratory leads to patient receiving platelets of an unsuitable group

A 4 year old patient was transferred from another hospital with history of HSCT for acute lymphoblastic leukaemia. The medical team failed to communicate the protocol and patient was transfused a unit of platelets which were of an unsuitable ABO group. Post transplant the patient's own group was O D-positive, donor group was A D-positive. The protocol stated that the patient should be issued group A platelets. Group O platelets were issued and transfused.

COMMENTARY

The individual steps in the transfusion process incorporate independent checks at each stage which are designed to confirm the details and so to detect earlier errors (BCSH Harris et al. 2009).

The pre-administration bedside check is a fundamental step as it is the final opportunity to detect a previous error and prevent a wrong transfusion. This final check could have detected 162/265 (61.1%) of these cases, and thus prevented transfusions of incorrect blood components.

References

BCSH Gibson BES, Todd A et al. (2004) **BCSH Transfusion guidelines for neonates and older children**. Br J Haematol 124,433–453 http://www.bcshguidelines.com/4_haematology_guidelines.html?dpage=2&dtype=Transfusion&sspage=0&ipage=0#gl [Accessed 30/03/2015]

BCSH Harris A M, Atterbury CLJ et al. (2009) **BCSH Guidelines on the administration of blood components**. http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf [Accessed 30/03/2015]

BCSH Jones J, Ashford P et al. (2014) **Guidelines for the specification, implementation and management of IT systems in hospital transfusion laboratories**. Transfus Med 24(6), 341-371 http://www.bcshguidelines.com/documents/IT_guidelinesAug14_final.pdf [accessed 10 March 2015]

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

BCSH Treleaven J, Gennery A et al. (2011) **Guidelines on the use of irradiated blood components, prepared by the British Committee for Standards in Haematology blood transfusion task force**. Br J Haematol 152, 35–51. doi: 10.1111/j.1365-2141.2010.08444 http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2141.2010.08444.x/full [Accessed 12/03/2015]

Cid J, Lozano M et al. on behalf of the BEST collaborators (2015) **Low frequency of anti-D following D+ platelet transfusion: the Anti-D Alloimmunisation after D-incompatible Platelet Transfusions the ADAPT study**. Br J Haematol 168, 598-602

SaBTO Cytomegalovirus tested blood components – Position statement. (March 2012) https://www.gov.uk/government/news/provision-of-cytomegalovirus-tested-blood-components-position-statement-published [Accessed 30/03/2015]

UKTLC Chaffe B, Glencross H et al. (2014) **UK Transfusion Laboratory Collaborative: Recommended Minimum Standards for Hospital Transfusion Laboratories**. Transfus Med 2014 24(6), 335-340 http://onlinelibrary.wiley.com/doi/10.1111/tme.12153/full [Accessed 30/03/2015]

Avoidable, Delayed or Undertransfusion (ADU) n=185

10

Authors: Julie Ball and Paula Bolton-Maggs

Definition:

- **Where the intended transfusion is carried out, and the blood/blood component itself is suitable for transfusion and compatible with the patient, but where the decision leading to the transfusion is flawed**
- **Where a transfusion of blood/blood component was clinically indicated but was not undertaken or was significantly delayed**
- **Avoidable use of emergency O D-negative blood where group-specific or crossmatched blood was readily available for the patient**

What to report:

- Prescription of components that are not required or are inappropriate as a result of erroneous laboratory results, transcription errors or faulty clinical judgement
- Prescription for an inappropriate indication
- Prescription at a dose or rate inappropriate for the patient's needs, excluding those cases which result in transfusion-associated circulatory overload
- Failure to transfuse when indicated, undertransfusion and significant delays in transfusion, whether caused by the laboratory or the clinical area

Key SHOT messages

- Avoidable and delayed transfusions continue to occur, many associated with poor communication or inappropriate clinical decisions contributing to bad outcomes including death
- The number of delays reported has increased; many were caused by misunderstandings related to the operation of major haemorrhage protocols (MHP). It is disappointing that ignorance of MHPs is still recorded 4 years after publication of the Rapid Response Report by the National Patient Safety Agency (NPSA) (NPSA 2010). It has been suggested that hospitals which have infrequent activations do not need to run practice drills but the opposite is the case. When MHPs are infrequently triggered the lack of familiarity may contribute to confusion as illustrated here
- The recommendations made in the NPSA Rapid Response Report remain relevant and should be followed, notably that 'local protocols should enable release of blood and blood components without the initial approval of a haematologist' and that the major haemorrhage protocol is 'supported by training and regular drills'

Overview

There were 185 reports of avoidable (n=129), delayed (n=50) or undertransfusion (n=3). Three additional cases are discussed under 'miscellaneous'.

- Age range: birth to 98 years (median 67) with 3 of unknown age
- Paediatric patients (i.e. <18 years of age) n=18

Deaths n=3

In three cases delay in transfusion contributed to the patient's death.

- Two were related to communication and confusion during activation of the major haemorrhage protocol (MHP) including a patient with a 'do not resuscitate' order
- One: the patient attended a routine anticoagulant clinic with symptoms suggesting gastrointestinal bleeding. He was admitted to the emergency department (ED) and later died. This case is discussed fully in Chapter 8, Human Factors, Case 1

Major morbidity n=4

Case 1: Elderly patients are vulnerable if transfusion is delayed

A 90 year old man deteriorated following surgery for a fractured neck of femur; delay in transfusion occurred because the urgency was not clear and he suffered cardiac arrest but was successfully resuscitated.

Case 2: Delay caused by inappropriate advice to used washed red cells

A 25 year old mother with obstetric haemorrhage and post-delivery Hb 67g/L suffered a transfusion reaction to a second unit of blood; the first unit had been started at 15:40. She was promptly reviewed (20:40, Thursday evening) but when the consultant haematologist was consulted at 02:00 he advised that washed red cells should be given. She continued to bleed dropping her Hb to 51g/L, then to 48g/L and was very frightened by 07:00 when the washed red cells were available. She then received 3 units. Surgery for retained products of conception was likely to be delayed until after the weekend (Monday) when further washed cells would be available, but when the Blood Centre consultant was contacted on the Sunday the advice was that washed cells were not necessary so surgery proceeded on the Sunday. As a result, a letter was issued regionally to clarify the indications for washed or plasma-reduced components.

Case 3: Failure to take notice of the medical history

A 63 year old woman had a history of autoimmune haemolytic anaemia (AIHA) for which she was on steroids, which was not noted in her pre-surgery clerking by the nurse (although it was listed in the GP referral letter). One week later she attended for day case surgery (repair of ventral hernia). The surgeon and anaesthetist were informed of her history of AIHA and also that in the past a splenectomy had to be abandoned (uncontrolled bleeding). A group and antibody screen sample was not taken. Postoperatively she became hypotensive and Hb was 56g/L at 00:43. Irregular antibodies were detected in the blood grouping sample and there were no compatible units in the hospital. The history of AIHA was noted when reviewed by the Critical Care team at 08:15 (followed by transfer to intensive care). The surgeon was adamant that the low Hb was caused by AIHA and not haemorrhage, despite the fact that the blood results and film reviewed by the haematologist did not fit with this. However at 12:00 imaging confirmed internal bleeding. At surgery 2.5L was evacuated. Red cells O D-negative were issued by concessionary release and given with hydrocortisone cover. She received 5 units of red cells, 2 units of FFP and 1 unit of platelets.

This case demonstrates complications that can arise, putting the patient at serious risk, when significant medical history is ignored. In this case the surgical pre-assessment was seriously inadequate, and there was failure to activate the major haemorrhage protocol once the bleeding occurred. Further MHP training will be undertaken.

Case 4: Misunderstanding of the MHP

A 41 year old woman suffered major obstetric haemorrhage losing more than 5L after abruption of the placenta and fetal death. She presented at 22:15 and delivery by caesarean section was planned. The coagulation screen was abnormal. At 01:15 a major obstetric haemorrhage (MOH) call was made, but there was delay in provision of blood components which may have contributed to the overall blood loss. The haematology biomedical scientist was unclear what blood products to issue after a MOH call and mistakenly thought authorisation by a haematology registrar was required. The process has been clarified. The patient was admitted to the intensive therapy unit (ITU) but made a full recovery.

Other cases illustrating difficulties with major haemorrhage protocols (MHP) n=8

The causes in 8 cases included: failure to activate the MHP (including Case 4 above), poor communication or a delay in decision-making and problems during major haemorrhage.

- In 2/8 delay contributed to the patient's death (see above)
- In 1/8 delay during massive obstetric haemorrhage was due to
  - Poor communication between the clinical area and the laboratory staff
  - The maternity clinical support worker did not use correct documentation to collect blood from the laboratory
  - Because of the urgent clinical situation the BMS released the components without further checks

Avoidable transfusions n=129

Cognitive errors (poor clinical decisions) n=27

All of these avoidable transfusions could have been prevented with adequate pre-transfusion assessment of the patient including:

- Review of current blood results prior to deciding to transfuse
- Avoiding incorrect management of immune thrombocytopenic purpura (inappropriate administration of a platelet transfusion when not bleeding)
- Avoiding treatment of non-bleeding patients suffering from liver disease with FFP
- Avoiding use of FFP to manage warfarin reversal, the correct management is with prothrombin complex concentrate (PCC)

In other instances the patient's specific care plan was not followed e.g. units reserved for surgery were prescribed and transfused the night before the surgery without any indication, or wrong patient transfused due to a misunderstanding of instructions on the ward round.

Transfusion on the basis of wrong results n=26

Reason	Number of cases
Cause of erroneous result unknown	10
Transcription error	5
Result of another patient used	4
Previous result used	4
Incorrect result issued	3
Total	**26**

Table 10.1: Erroneous results leading to avoidable transfusions n=26

In 10 cases the cause of the erroneous result could not be established but 5/10 probably resulted from dilute or inadequate samples. In 4/26 cases the blood result of another patient was used following errors when viewing or linking patient results on the hospital information technology (IT) system.

Case 5: A patient with poor intravenous access and multiple co-morbidities receives unnecessary blood transfusion due to wrong results from possible poor full blood count (FBC) sample

A 68 year old woman with multiple co-morbidities had a Hb recorded 2 days before at 97g/L, but a repeat showed Hb 40g/L (no clinical symptoms to fit with severe anaemia) which triggered a transfusion request. This was handed over for the on call doctor to prescribe. A repeat FBC sample was taken since the low Hb was unexpected and not consistent with the clinical findings, but nobody was informed. The first unit was started at 19:35. The second unit was started at 00:05 after insertion of a new cannula under ultrasound guidance (very difficult access due to oedema). At this time (00:05) the result of the repeat FBC was viewed (available at 18:18, 6 hours earlier): result Hb 95g/L. The transfusion was stopped at 00:25. The patient was currently asymptomatic, haemodynamically stable with no evidence of bleeding. The transfusion documentation/plan in the patient's notes was poor with no evidence of a decision to transfuse or that a repeat sample had been taken after the apparent fall in haemoglobin.

Sample errors n=22

In 22 cases the primary error was an inadequate, clotted/clumped, dilute or 'wrong blood in tube' FBC sample.

Table 10.2: Causes of FBC sample errors n=22

Error	Number of cases
Dilute	7
Inadequate	3
Clotted/clumped	6
Wrong blood in tube	6
Total	**22**

One additional 'wrong blood in tube' FBC sample resulted in delayed transfusion. This is discussed in the section on delays with an additional sample-labelling error.

Blood gas analyser/point-of-care testing (POCT) errors n=9

Wrong results from blood gas analysers and other POCT devices continue to be reported. In 9 instances an erroneous result was used as the basis for transfusion. The advantages of near patient testing are well documented (Briggs et al. 2008, Briggs et al. 2012) however clinicians are reminded that all staff must be trained and competent to use these devices and care must be taken when reading and interpreting results.

Avoidable use of O D-negative red cells n=17

In all these cases, more suitable red cells should have been available however, due to various errors in the process, emergency O D-negative units were used instead.

Table 10.3: Reports of avoidable use of emergency O D-negative red cells n=17

Reason	Number of cases
No preoperative group and antibody screen available	2
Type-specific red cell units available	2
Crossmatched red cell units available	4
Non-emergency situation	1
Group-check sample not taken	2
Crossmatched red cell units stored in wrong refrigerator	1
Patient's condition did not require emergency transfusion	2
Group and antibody screen sample lost	1
Emergency O D-negative red cell units taken instead of available group-specific units	1
Group and antibody screen sample labelling error	1
Total	**17**

In 2 cases emergency O D-negative units were issued because a group-check sample was not available. In a third case there was delay in transfusion of O D-negative red cells and this case is discussed later (Case 8).

Haematinic deficiency n=13 (the numbers do not relate to the case studies in the text)

Table 10.4: Red cell transfusions in patients with haematinic deficiency n=13

Case	Deficiency	Indication for transfusion	Symptoms Y/N	Hb and other indices where known Pre-transfusion	Number of red cell units given	Hb Post-transfusion
1	B12	Symptomatic anaemia secondary to possible GI bleed	Y	73g/L	2	87g/L
2	Iron	Chronic GI bleed	Y	36g/L	3	Not done prior to discharge
3	B12	GP referral with instruction to refer to haematologist on admission as blood tests showed B12 deficiency	Y	Hb unknown B12 75pg/mL folate 3.1ng/mL	4	unknown
4	Iron	Hb sample from 6 weeks earlier prior to iron treatment	N	67g/L, MCV 52fL ferritin 8µg/L (pre-iron)	3	159g/L HCT 0.489
5	Iron	Decompensated liver disease – chronic anaemia	N	68g/L	2	82g/L
6	Iron	Peri-operative Hb<7g/L (laproscopic hysterectomy) (? Non-compliance with iron)	N	Hb 69g/L MCV 56fL	2	unknown
7	Iron	Transcription error by nurse. Wrong patient transfused	N	unknown	1	unknown
8	Iron	Chronic anaemia	N	38g/L	4	114g/L
9	Iron	Menorrhagia – endometrial ablation	N	82g/L	1	98g/L
10	Iron	Listed for endoscopy	N	76g/L MCV 69.4fL ferritin 7µg/L:	3	124g/L
11	Iron	Aim for 100g/L post transfusion	N	84g/L	1	unknown
12	Iron	Preoperative hip replacement – chronic anaemia	N	Hb 56g/L MCV 62fL ferritin 2µg/L	2	unknown
13	Iron	Pregnant – fatigue and dizzyness	Y	65g/L	2	Clotted sample, not repeated

Inappropriate management of iron deficiency anaemia continues to occur. Where available the red cell indices are included otherwise classification is as given by the reporter.

Case 6: Inappropriate transfusion of patient with iron deficiency followed by development of multiple red cell antibodies

A 57 year old woman attended the preoperative clinic prior to an elective hip replacement. The Hb was reported as 62g/L. A routine transfusion of red cells was requested and prescribed by an orthopaedic trainee and the patient was planned to attend the haematology day case unit for transfusion. The junior haematology doctor did not review the patient before accepting her for transfusion and there had been no request for review by a consultant haematologist.

Results prior to the transfusion, which took place 5 days later, showed clear evidence of iron deficiency: Hb 56g/L, MCV 62fL, ferritin 2microg/L (folate and B12 levels normal). Two pre-transfusion antibody screens were negative. One month after transfusion, following iron therapy and endoscopy

to check for a possible source of gastrointestinal bleeding (no abnormality found), results were: Hb 105g/L MCV 77fL, ferritin 25microg/L.

A further preoperative group and screen sample 2 months later identified that the patient had developed anti-S, anti-E and anti-Lu^a following this unnecessary transfusion.

Overtransfusion n=7

This group included patients whose low body weight was not taken into consideration when prescribing the transfusion and includes two paediatric patients. There were 2 additional paediatric prescribing errors that resulted in overtransfusion (see below).

Prescription errors n=7

Components were incorrectly prescribed in 4 cases. Two of these were paediatric patients. Two transfusions of red cells to adult patients were prescribed to run in excess of 4 hours; one over 6 hours and the other over 8 hours. In a further 3 cases, transfusions were given that were neither prescribed nor appropriate.

Other n=1

Case 7: A Jehovah's Witness receives red cells

An 85 year old woman with a fractured hip and known dementia appeared to have consented to transfusion as part of the consent process for emergency surgery. In a previous admission a few months earlier for possible upper gastrointestinal (GI) bleed, she had expressed her preference not to receive blood transfusions and this was documented in the case notes together with a plan for conservative management with an iron infusion. There was no advanced directive.

Following a cardiac arrest on induction of anaesthetic for the hip surgery, the patient was returned to the ward, the 2 units of red cells which had been crossmatched prior to surgery were prescribed (Hb 67g/L MCV and MCH consistent with the blood sample at 04:53, more than 8 hours earlier) and the first unit was commenced at 14:40 and completed at 18:30. When the second unit was commenced at 21:30 the family raised a concern regarding the transfusion.

The validity of the patient consent in this case was clearly in question due to the patient's long term confusion. The patient's wishes and agreed management plan had been discussed with the patient in the presence of family members during a previous admission and this was documented in the case notes. There was no formal objection to transfusion (advanced directive) however, information about the patient's religion and decision to decline blood transfusion was available but this information had not been added in the recognised field of the electronic admission record. The patient reiterated her objection to transfusion when she recovered from the event.

Delayed transfusions n=50

There were 50 reports of delayed transfusion in 2014, an increase from previous years (Figure 10.1). Analysis provides important lessons and reflects the difficulties of managing patients in busy hospitals. The outcome of the root cause analyses (RCA) and corrective measures taken to address issues raised are useful learning tools which should be shared to continue to enhance patient outcomes and support other colleagues in practice. We encourage reporters to share anonymised RCA reports. Please contact the SHOT office.

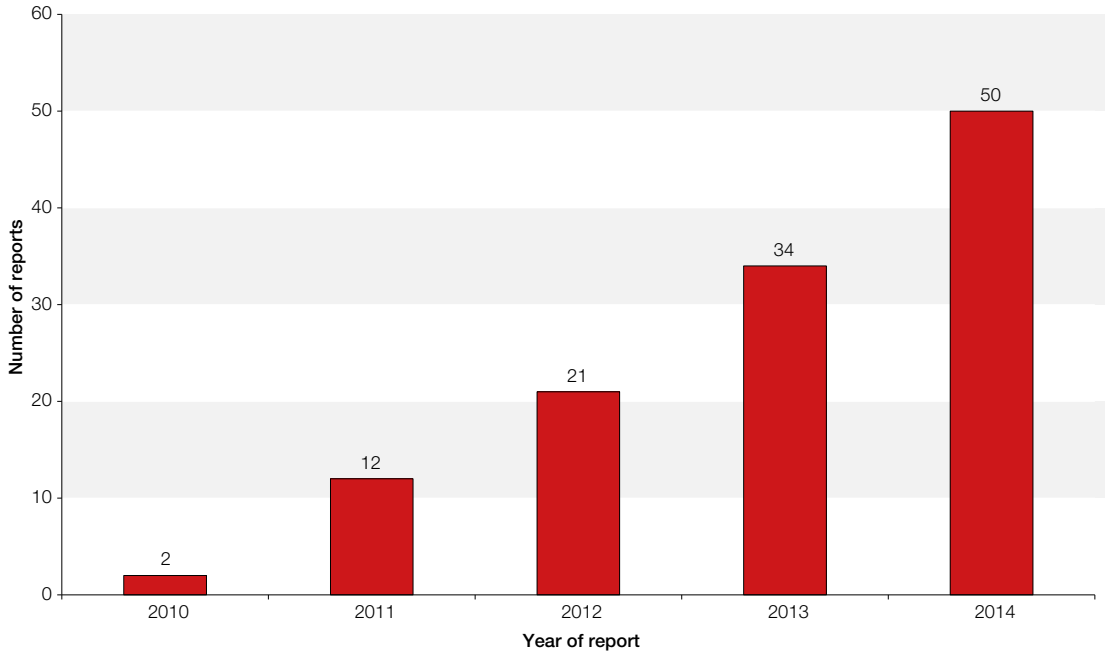


Figure 10.1: Cumulative numbers of reports of delayed transfusion n=119

Component not available n=10

In 10 cases components were not readily available for patients requiring transfusion.

- Two were routine transfusions and were linked. The BMS from the 'hub' transfusion laboratory inadvertently switched the delivery location of the components for the two patients who were in two separate 'spoke' hospitals. The error was detected by a nurse who contacted the transfusion laboratory. The components were recalled but this mistake resulted in delay in transfusion for the patients
- The other 8 cases were either urgent (5/10) or emergency (3/10) transfusions. Reasons identified for the delays included failed communication between departments about exact requirements or availability and delays while suitable components were sourced

In 2 of the above cases the problems occurred with collection of the component.

- A ward had recently relocated and the staff were unclear where they could collect blood from
- A porter was delayed in collecting blood for theatre due to the demands from other theatres

Communication failures n=17

These included failure to communicate the urgency (n=7) and other communication problems (n=10)

Case 8: Miscommunication and misunderstandings complicated by poor venous access leads to a delayed transfusion

An 81 year old man was admitted through the ED at 16:40 following a fall at home and possible compartment syndrome. He was receiving warfarin for atrial fibrillation and the INR was 4 at the time of the fall. On admission his Hb was 76g/L and INR 1.7, BP was 70/40mmHg, heart rate 98bpm, respiratory rate 32 breaths per minute and oxygen saturation 97%. The patient had visited the GP 24 hours earlier when his Hb was 112g/L. At 17:30 the patient was reviewed and was found to have no pulses in the foot due to an extensive haematoma. Prothrombin complex concentrate (PCC) and vitamin K were prescribed following discussion with the consultant haematologist.

At 18:30 the patient was reviewed by the consultant vascular surgeon who prescribed red cells. Blood was issued within 20 minutes together with PCC based on results from the GP. The PCC was given at 19:45, and a second grouping sample was requested prior to transfusion in accordance with the standard operating procedure. The clinical staff 'refused' to take a repeat sample and the BMS

would not release crossmatched red cells without the confirmation group. The clinical staff ordered emergency O D-negative red cells. The patient was transferred to ITU at 21:00 where the red cells were transfused. He was then transferred to theatre for evacuation of the haematoma with a 2L blood loss. A repeat group and antibody screen sample was taken at 22:55 and fully crossmatched units were issued and collected at 23:30.

On investigation there were several circumstances surrounding the events:

The ED was extremely busy, the patient had only one line of venous access, was shut down and difficult to bleed. ITU staff had been contacted to arrange central line insertion and to take over the patient's care. The ED team gave IV Vitamin K in a syringe driver over 1/2 hour (rather than as a bolus over 3-5 minutes) which caused delay. IV antibiotics were given which caused additional delay in giving PCC.

The vascular surgeon was very disappointed that no blood had yet been given to the patient and the O D-negative red cells were ordered to be given immediately so that the patient did not deteriorate any further.

The British Committee for Standards in Haematology (BCSH) guidelines for pre-transfusion compatibility procedures (BCSH Milkins et al. 2013) are clear regarding the need for a group-check sample and what to do in an emergency if it is not possible to obtain a second sample. There were 4 cases reported in 2014 relating to this. In 1 case the clinical staff refused to take a second sample and used the emergency O D-negative units.

In another case, in a woman aged 75 with GI bleeding, the group-check sample was labelled with the wrong patient details leading to delay in supplying red cells. However the BCSH guidelines (BCSH Milkins et al. 2013) clearly state that although a second sample should be requested for confirmation of the ABO group of a first time patient, this '**should not impede the delivery of urgent red cells or other components when urgent transfusion is required**'. In this case the laboratory BMS was also unaware of the exceptions to the 2 sample policy and this caused confusion/conflict and delay in receiving crossmatched blood.

Local review of this case unearthed frequent inappropriate practice: while bedside printing of labels was supposed to be in place there were insufficient printers so several users were printing out labels on a single printer, readily enabling collection of incorrect labels and labelling the wrong sample. As a result of this incident, the staff have returned to a policy of hand writing labels and a working party has been set up to review the blood sampling procedures across the hospital.

Wrong blood in tube: group and antibody screen n=2, FBC WBIT n=1 and sample-labelling error n=1

All four cases resulted in delayed transfusion.

An urgent sample for a patient with a GI bleed could not be located. It had been labelled with another patient's details and had been accepted and tested by the laboratory as the details on both the form and sample matched.

In the 'wrong blood in tube' FBC case, patients A and B were in adjacent beds. The full blood count sample from patient A was labelled with patient B's details. As a result, patient B received an unnecessary unit of platelets while patient A's transfusion was delayed until the error was discovered by the junior doctor when reviewing the biochemistry results.

In the sample-labelling case, the BMS requested a repeat FBC with a group and screen for patient S in the Emergency Department whose Hb was 46g/L. Two samples were received in the laboratory at the same time; one for patient S and a second for patient Y with clinical details recorded as 'Hb 4.6 on previous sample'. This was consistent with patient S. The BMS suspected that the patient details had been transposed during labelling, rejected the samples and requested they be repeated. When the clinical area contacted the laboratory to find out when blood would be available for the patient, the BMS was assured that the samples came from patient S, they had just been labelled with the wrong details and requested the sample be run anyway due to patient condition. The BMS refused and issued group specific when they received a repeat sample.

Although there have been no reports submitted to SHOT in the last 2 years where wrong components were transfused as a result of 'wrong blood in tube' group and antibody screen samples, patients are still receiving unnecessary or delayed transfusions due to errors and failures to positively identify patients when labelling other pathology specimens. This task must be completed according to the BCSH administration of blood component guidelines (BCSH Harris et al. 2009) and as recommended by SHOT (Bolton-Maggs, Poles et al. 2013).

Delayed decision making n=5

All 5 of these occurred in 'urgent' (2 cases) or 'emergency' (3 cases) situations as shown in Case 3 above and Case 6 in Chapter 8 Human Factors.

Case 9: Elderly patient with epistaxis poorly managed due to lack of ownership

An elderly woman was admitted to the ED with epistaxis (not on anti-coagulants) and was prescribed a 2-unit blood transfusion due to the severity of the bleeding (Hb 109g/L). The units were issued but were not given as nursing staff were trying to move patient before she breached the target time in the ED (4 hours). The patient had been referred and initially accepted by the surgical team who then declined the patient. She remained in the ED for another 2 hours but the transfusion was not started. She was reviewed by the Consultant who decided instead she was to be urgently transferred to another hospital (by 'blue light'). The blood was not used on transfer.

Case 10: Delayed admission following failure of communication in community care

A FBC sample was received on routine transport from a health centre. The clinical details included 'shortness of breath' and the Hb was 45g/L. As the sample was received after routine hours, the result was telephoned to the on-call GP service. The patient was not admitted to hospital until 6 days later. A repeat Hb confirmed the low result, and resulted in an urgent request for a 3 unit red cell transfusion which was started within 2 hours.

Component labels n=3

Two cases of transposed labels were detected at the bedside and components were therefore recalled for relabelling. In the third case the Blood Service provided HLA-matched platelets for two patients who had received HSCT but as a result of transplant, both had new ABO groups. The supplied platelets were of the original ABO group, not the new post-HSCT ABO group. The Blood Service laboratory staff are unable to change the blood group on their LIMS but agreed to provide platelets of the updated groups (which had been indicated on the original request forms). The platelets had to be returned to the hospital transfusion laboratory for checking which resulted in a delay in the transfusion.

Sample labelling errors n=5

All these incorrectly labelled samples were for group and antibody screens.

Case 11: Wrong date of birth recorded by GP leads to confusion, 7 mislabelled samples and consequent delay in transfusion

A 92 year old woman was admitted with chest pain, Hb 51g/L and as there was no previous record of her blood group, 2 independent samples were required. The month of birth on the hospital system was recorded as October as given by the GP, but in fact was September. The grouping samples were rejected on 5 consecutive occasions because of sample labelling errors. A doctor took two samples and completed the details on both samples but another member of staff signed for second sample (against hospital policy so rejected by the laboratory). The third sample had a mismatch between the date of birth given (September) on the sample, correct, and (October) on the form and so was again rejected. Fourth and fifth samples were collected, blood was then matched and 2 units issued more than 3 hours after the low Hb was telephoned to the clinical area.

However, bedside positive patient identification check at the time of administration established that the date of birth was incorrect. (The positive patient identification phlebotomy policy had not been followed for previous samples). Patient details were then updated on the hospital system, a new

wristband was provided, new blood request forms printed and the patient was rebled for sixth and seventh times with correct DOB. The patient was suffering from GI bleeding and the blood was issued urgently. The transfusion started at 16:25 nearly 6 hours after admission.

Other reasons for delay n=6

- In 2 cases the patient was being transferred between wards and the transfusion was not started because of this
- In 2 cases the delay was due to the late receipt of a group and antibody screen sample
- In 1 case an erroneous full blood count result with an unknown root cause resulted in delay
- In 1 case the staff could offer no explanation why an overnight transfusion had not been started as prescribed for a patient who needed it. The plan was made at 01:30 and the first unit was given by 06:30 however, the second unit was not commenced until 17:30 later that day. Therefore this second unit was delayed by >12 hours

Undertransfusion n=3

In all three cases, the dose of FFP was insufficient. In two cases the FFP was to be given before a procedure but in the third case the patient was undergoing surgery where three units were prescribed but only one was given. Lack of knowledge and poor prescribing were cited as the main cause of these cases.

Miscellaneous cases n=3

Two cases relating to prothrombin complex concentrate (PCC) are discussed here and we will accept such cases or instances of delayed PCC administration. Please contact the SHOT office if you have a case.

Case 12: Miscommunication regarding PCC causes inappropriate administration

A patient with history of haematuria had an INR of 8.9. The ward contacted the hospital transfusion laboratory requesting PCC. The BMS told the ward staff to discuss this request with the consultant haematologist. There was no further communication between the ward and the hospital transfusion laboratory. The next day, a request was received for PCC. The ward staff confirmed this had been agreed by the consultant haematologist. The PCC was issued and was transfused at 17:00. However, a repeat sample, taken at 15:00, gave an INR result of 1.5, thus the PCC was given unnecessarily. The nurse who administered the PCC had confirmed with the doctor that there was no INR result at that time. The doctor stated that the consultant said to go ahead with transfusion. Training sessions were to be set up for the nurses and doctors as PCC was not a regular treatment on the ward.

We have received several enquiries about reporting PCC incidents and have decided to accept reports of inappropriate or delayed administration of PCC. Reporters should contact the SHOT office for reporting guidance and to request the relevant questionnaire.

Case 13: Confusion when porter collected blood components in an emergency

An elderly man was admitted with an intracranial haemorrhage. The porter came to the hospital transfusion laboratory and informed the BMS that the massive haemorrhage protocol (MHP) had been activated. The laboratory staff had not received a telephone call from the clinical area to activate the MHP. The porter had brought hand written patient details without a hospital number. The BMS tried to contact the ward, but got no answer. He/she then created a 'LIMS ID' number to permit issue of 2 units of O D-negative blood and 2 units of FFP with appropriate documentation. The BMS was unable to print the issue record so the porter was allowed to take the units of blood without signing them out. The BMS then received a telephone call from the clinical area. The nurse in charge clarified the patient details. The BMS explained the risks of transfusing incorrectly labelled components and advised about MHP requirements including the need for an urgent crossmatch sample and an emergency ID number. The doctor then explained that the patient had an intracranial

bleed and required PCC not blood components. The components were returned to the laboratory within 15 minutes.

An additional case did not meet inclusion criteria for SHOT. The patient received an inadvertent peripheral arterial red cell transfusion. The staff were initially alerted when the appearance of the component changed in the bag during transfusion. This was confirmed when attempting to administer antibiotics.

Near miss ADU cases n=14

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

Point in the process	Type of error made	Number of cases	Percentage of cases
Request	Requested excessive volume or rate of transfusion of blood component	5	35.7%
	Requested on the basis of erroneous results	5	35.7%
	Requested for incorrect patient	2	14.3%
Sample taking	Wrong blood in tube FBC sample	2	14.3%
Total		**14**	**100%**

Table 10.5: Near misses that could have led to ADU n=14

IT-related ADU cases n=12

There were 12 ADU cases that also had an IT element, and these are described below. The numbers are included in the tables above where appropriate, so these are not additional cases. There were 6 clinical errors, and 6 laboratory errors.

Transfused on the wrong result n=8

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

In two patients the platelets were low due to clumping or clotting but these spuriously low platelet counts, results which should not have been transmitted, appeared on the ward results enquiry system and both patients were give unnecessary platelet transfusions. On another occasion a faulty coagulation analyser gave an incorrect fibrinogen result and a baby was given a blood component that was not indicated.

In five cases clinical staff prescribed blood components because the wrong patient's record had been accessed.

- On two occasions, red cells were transfused to a patient based on a Hb result accessed via a ward computer for a different patient
- An unnecessary transfusion was given to a patient because they had two computer records, which had not been linked or merged. The low Hb level was an old result and the latest Hb was much higher and, as a result, the patient was overtransfused
- In one case the haematology laboratory picked up a wrong blood in tube (WBIT) on a delta check but the result was not withdrawn and the patient was transfused based on another person's results
- In the fifth case incorrect transcription of the platelet count from the computer to the patient's notes resulted in a platelet transfusion that was not needed

Transfusion delays n=4

IT systems or equipment failure led to transfusion delays in four patients:

- A delay occurred in providing blood for a postoperative surgical patient who did not have a current valid group and screen to enable issue of blood remotely. Although testing was undertaken in a timely manner, the LIMS did not release the results in a timely way and the patient ended up needing

emergency blood. This highlighted a problem with the remote issue set up that needed revising

- A woman who needed urgent transfusion of SD-FFP had a delayed transfusion because the labels for the component could not be generated during computer downtime
- Platelets with the wrong specific requirement were ordered for a patient because the flag on the LIMS which indicated that irradiated components were required was ignored and the platelets had to be reordered
- Blood could not be provided in an urgent situation because there was a wrong DOB on the PAS, which led to a difference between the request and the sample and multiple sample rejections

COMMENTARY

The number of reported delays to transfusion in 2014 has increased to 50 compared to 34 in 2013. Many reports demonstrate that there are still misunderstandings about activation of the MHP. It has been suggested that hospitals which have infrequent activations do not need to run practice drills but the opposite is the case. When MHPs are infrequently triggered the lack of familiarity may contribute to confusion as illustrated here. The recommendations made in the National Patient Safety Agency Rapid Response Report remain relevant and should be followed, notably that 'local protocols should enable release of blood and blood components without the initial approval of a haematologist' and that the major haemorrhage protocol is 'supported by training and regular drills'. It is disappointing to receive reports related to failure to put these arrangements in place some 4 years after publication.

The number and reasons for avoidable transfusion are similar to previous years.

References

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

BCSH Briggs C, Guthrie D et al. (2008) **Guideline for point-of-care testing: haematology**. Br J Haematol 142, 904-915

Bolton-Maggs PHB et al. (2013) **Annual SHOT Report 2012**. www.shotuk.org [Accessed 30/03/2015]

Briggs C, Kimber S et al. (2012) **Where are we at with point-of-care testing in haematology?** Br J Haematol 158, 679-690

National patient safety agency (2010) **The transfusion of blood and blood components in an emergency**. Rapid Response Report 017: 21 October 2010 http://www.nrls.npsa.nhs.uk/resources/?EntryId45=83659 [Accessed 03/03/2015]

Summary of Events Originating in the Hospital Transfusion Laboratory n=334

11

Authors: Hema Mistry and Peter Baker

Key SHOT messages

- Errors with sample receipt and registration, and testing all highlight key areas for improvement, particularly lack of effective communication together with poor serological knowledge and understanding in laboratory staff. During the 'booking in' process it is essential to take into account any historic patient laboratory information and to ensure that all previous results and any specific requirements have been taken into consideration
- The modern transfusion laboratory is critically dependent on IT and automation. Worryingly, there has been a number of cases in 2014 where the error in relation to the use of IT may have been an error in the actual software or function of the IT system
- The BCSH guidelines on IT in blood transfusion (BCSH Jones et al. 2015) and the UKTLC standards (Chaffe et al. 2014) have both been published recently, and laboratory staff are strongly encouraged to perform a gap analysis and ensure their laboratories comply with them

This chapter includes all errors that originated in the laboratory associated with:

- Sample receipt and registration: information missed or not heeded during the 'booking in' stage
- Testing: pre-transfusion testing and procedural errors
- Component selection: selecting an unsuitable blood component
- Component labelling, availability and handling and storage of blood components: labelling errors, availability surrounding blood components and their correct storage conditions
- Miscellaneous: cases that are difficult to assign to any of the above steps

Analysis of all cases reported to SHOT in 2014 shows that 2346/3017 (77.8%) were caused by error. Of these 334/1179 (28.3%) full cases originated in the laboratory, Table 11.1, and there were a further 313/1167 (26.8%) laboratory-related near miss cases, Table 11.2.

Table 11.1: Laboratory errors n=334

Laboratory categories	Total	Percentage	Chapter					
			IBCT	SRNM	HSE	RBRP	ANTI-D	ADU
Sample receipt and registration	94	28.1%	9	45	4	22	12	2
Testing	88	26.3%	11	32	9	0	23	13
Component selection	39	11.7%	13	8	6	1	11	0
Component labelling, availability, handling and storage	109	32.6%	3	0	44	50	2	10
Miscellaneous	4	1.2%	0	1	0	0	3	0
Total	**334**	**100%**	**36**	**86**	**63**	**73**	**51**	**25**

Key: IBCT – incorrect blood component transfused; SRNM – specific requirements not met; HSE – handling and storage errors; RBRP – right blood right patient; ADU – avoidable, delayed and undertransfusion.

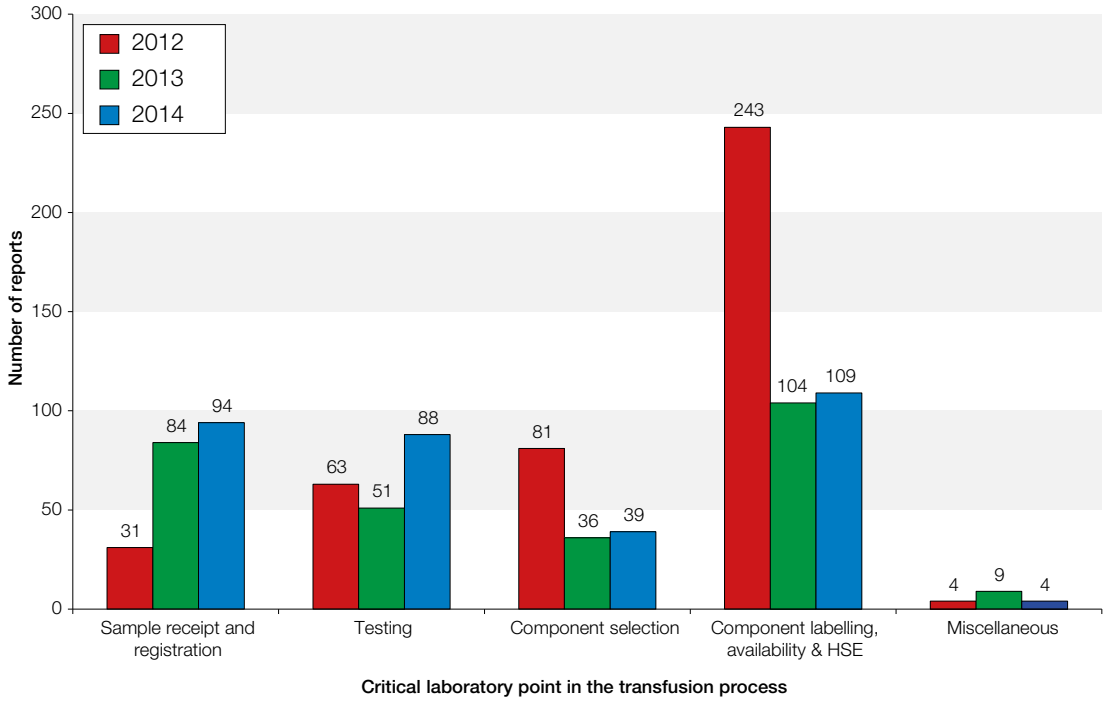
In 313 near miss cases the errors were detected prior to transfusion. This illustrates that when procedures are followed and staff involved in the transfusion process perform their role effectively, errors can often be detected before transfusion.

Table 11.2: Near miss laboratory errors n=313

Near miss laboratory categories	Total	Percentage	Derivative chapter					
			IBCT	SRNM	HSE	RBRP	ANTI-D	ADU
Sample receipt and registration	58	18.6%	14	29	0	14	1	0
Testing	36	11.5%	21	12	0	0	3	0
Component selection	68	21.7%	17	17	11	0	23	0
Component labelling, availability, handling and storage	150	47.9%	7	1	51	85	6	0
Other: bacterial contamination of a unit of platelets	1	0.3%	0	0	1	0	0	0
Total	**313**	**100%**	**59**	**59**	**63**	**99**	**33**	**0**

Figure 11.1 shows the 3 year trend and indicates the critical points in laboratory processes where errors occur.

Figure 11.1: Three year trend 2012-2014



The total number of laboratory cases reported in 2014 has increased n=334 compared with 2013 n=284. The number of cases related to sample receipt and registration and particularly testing errors have increased, Figure 11.1. The 4 cases classified as 'miscellaneous' are described later.

Sample receipt and registration errors n=94

Most errors at sample receipt and registration are similar to previous years. Failure to take into account available historic information accounts for 60/94 (63.8%), demographic data entry errors for 25/94 (26.6%) and information missed by laboratory staff that was provided on the request form for 9/94 (9.6%).

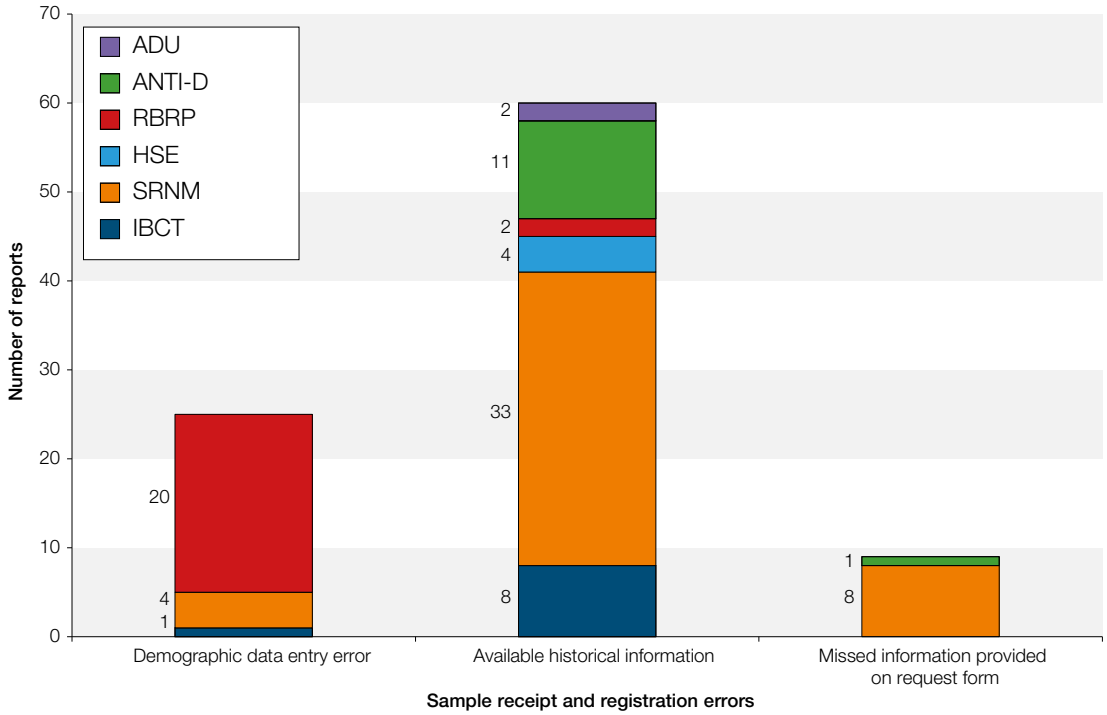


Figure 11.2: Sample receipt and registration errors n=94

The outcomes in each subcategory are given below, in Tables 11.3-11.5. The number of errors in 2014 for demographic data entry error have reduced, (35/84 cases in 2013, compared with 25/94 in 2014) and information missed by laboratory staff that was provided on the request form shows little change (10/84 cases in 2013, compared with 9/94 in 2014).

Demographic data entry error	Number of cases
Patient's name	9
Hospital/National Health Service (NHS) number	6
Date of birth	5
Ambiguous information regarding patient's previous history including antibody information and flags not being set up correctly	5
Total	**25**

Table 11.3: Demographic data entry error n=25

Available historic information missed on the LIMS	Number of cases	
Requirements or patient details on patient's historic record missed/not heeded	35	
Antibody history or specific requirements on patient records not heeded		*23*
Patient records not merged correctly		*7*
Flag not set up correctly		*3*
Flags not being activated		*1*
Shared care		*1*
Incorrect ABO/D group issued to patients including known haemopoietic stem cell transplant (HSCT) patients	8	
Anti-D immunoglobulin (Ig) inappropriately administered to women who had known immune anti-D	7	
Samples that had exceeded BCSH* sample timing guidelines (BCSH Milkins et al. 2013)	4	
Anti-D Ig inappropriately administered to a woman who had delivered a D-negative infant because the cord D status was not looked up and the infant was assumed to be D-positive	3	
Delay in transfusion due to information not being heeded on the patient's historical record i.e. correct blood group on the patient's record but the wrong blood group was ordered	2	
Anti-D Ig inappropriately administered to a known D-positive woman	1	
Total	**60**	

**BCSH = British Committee for Standards in Haematology*

Table 11.4: Available historic information missed on the laboratory information management system (LIMS) n=60

Table 11.5: Information missed by laboratory staff that was provided on the request form n=9

Details of information missed on request form	Number of cases
Request for irradiated components	6
Request for solvent-detergent fresh frozen plasma (SD-FFP)	1
Request for cytomegalovirus (CMV) negative (red blood cells)	1
Request for group and Kleihauer on maternal sample	1
Total	**9**

For an illustrative case and learning point about transfer of historic data from legacy systems to a new laboratory information system please see Case 9 in Chapter Incorrect Blood Component Transfused.

Table 11.6: Near miss sample registration and receipt errors n=58

Sample registration and receipt errors	Number of cases	Percentage of cases
Specific requirements not met	29	50.0%
Incorrect identifiers entered onto LIMS	14	24.1%
Sample booked under incorrect record	14	24.1%
Incorrect patient merge in LIMS/patient administration system (PAS)	1	1.8%
Total	**58**	**100%**

Testing errors n=88

Reports of testing errors have increased in 2014 compared with 2013 (n=51). The type of testing errors have been analysed below to highlight the different testing and procedural errors that are still recurring year after year.

Most errors that occurred in testing (Figure 11.3) were due to procedural errors:

- Incomplete testing in 54/88 (61.4%)
- Transcription errors in 14/88 (15.9%)
- Misinterpretation of results in 10/88 (11.4%)
- Technical errors in 10/88 (11.4%)

ABO/D grouping errors n=9

There were 9 grouping errors (5 ABO, 4 D), all involved manual intervention: interpretation errors n=5 and transcription errors n=4.

Case 1: Vague and non-prescriptive standard operating procedures (SOP) resulted in incorrect group interpretation

During a late shift for transfusion, a new sample was received from a 52 year old woman. The BMS performed a full forward/reverse group and also an abbreviated group in BioVue cassettes. Both groups gave a weak D-positive result. The BMS then performed a manual group that again gave a weak D-positive group and this was reported into the LIMS. The BMS then selected two D-positive red cell units which were compatible and transfused. A request for an additional unit was received and again a D-positive unit was compatible and transfused. The BMS tried to find the SOP but had not found any reference to weak D grouping in the automated grouping SOP. The ward later contacted the laboratory to state the patient believed she was D-negative. The BMS checked the SOPs again and found reference in the manual grouping SOP stating that a direct antiglobulin test (DAT) should have been performed, as a positive DAT can cause weak positive reactions with the anti-D reagents. The patient was found to have a weakly positive DAT and was confirmed to be D negative. The patient is being monitored to see if she develops anti-D. The incident investigation noted that the SOPs were vague but also there was no positive reaction with the anti-D control, which influenced the result interpretation.

Pre-transfusion testing is an essential part of the transfusion process: accurate ABO/D grouping is the most important serological test. Despite recommendations for fully automated grouping some laboratories continue to perform manual ABO/D grouping for example in emergencies or out-of-hours, and in very small laboratories where large automation is not feasible. SHOT supports the standards published by the UK Transfusion Laboratory Collaborative (UKTLC) in 2014 (Chaffe et al. 2014) for routine use of full automation for all samples throughout 24 hours, to eliminate manual errors.

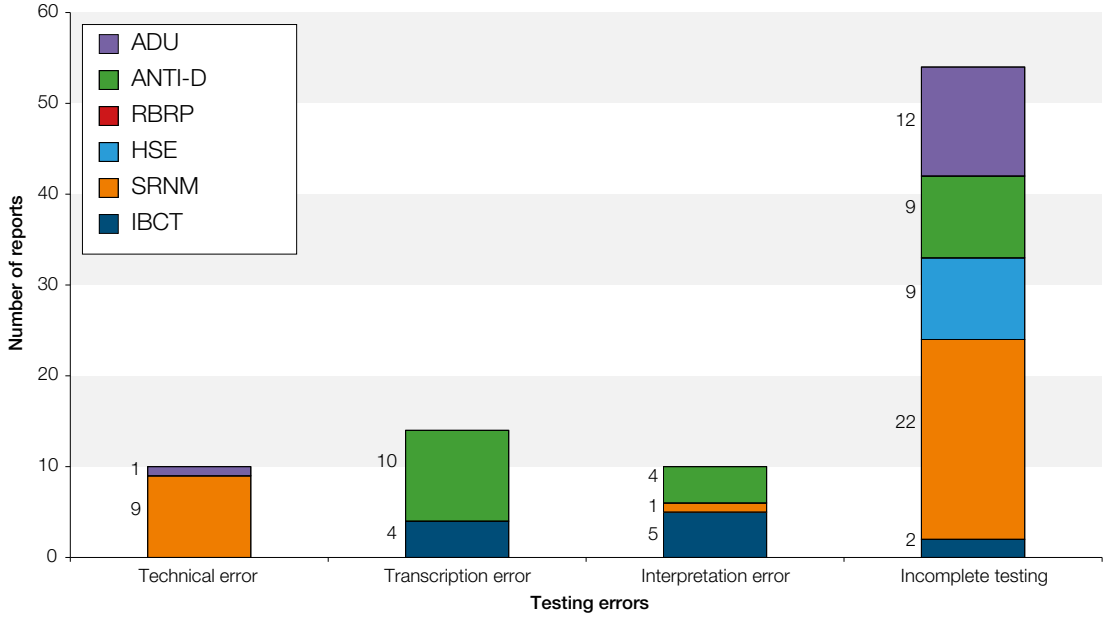


Figure 11.3: Testing errors n=88 with their outcome

These all resulted from laboratory staff not following SOP (incomplete testing).

Table 11.7: Procedural errors n=54

Procedural errors	Number of cases
Red cell units issued based on an invalid sample according to the BCSH guidelines (BCSH Milkins et al. 2013)	9
Clinically significant antibodies not excluded during antibody identification/positive antibody panel not fully identified (testing errors)	7
Components issued based on erroneous results (e.g. fibrinogen and Hb)	7
Antibody identification not performed following a positive antibody screen	7
Erroneous low platelet counts reported for patients whose platelets were known to 'clump' in ethylenediaminetetraacetic acid (EDTA)	5
Omission or late administration of anti-D Ig because Kleihauer test: a) Was not performed within 72 hours post delivery b) Was performed within 72 hours but anti-D Ig was not administered within 72 hours	4
Components issued based on a single sample and no confirmatory blood group check taken	3
D group performed on maternal sample rather than cord sample	2
Anti-D Ig issued to a D-negative mother who delivered a D-negative baby	2
Red cells transfused to neonate which were not crossmatched against the maternal sample which contained multiple alloantibodies	1
Red cells issued and transfused before crossmatch results had been confirmed	1
Blood group performed using invalidated methodology	1
Excessive dose of anti-D Ig administered because the BMS did not wait for the flow cytometry results which would have been available within 72 hours	1
Red cells issued from an incomplete crossmatch	1
Platelets issued on an incomplete group and antibody screen	1
Failure to perform DAT on a 1 day old baby prior to issue of red cells	1
BMS did not perform complete testing as stated in SOP for D status of patient following a mixed field reaction	1
Total	**54**

Table 11.8: Transcription errors n=14

Transcription errors	Number of cases
Cord samples tested post delivery incorrectly reported as D-negative resulting in omission of anti-D Ig to D-negative women	4
ABO/D group transcribed incorrectly onto LIMS	4
Cord samples tested post delivery incorrectly reported as D-positive resulting in inappropriate administration of anti-D Ig	3
Mother (D-negative) transcribed as D-positive was not given anti-D Ig in a timely manner	1
Inaccurate comments input into LIMS regarding testing that had been performed, resulting in red cell units being issued to the baby that were not crossmatched against mother	1
Misleading code entered onto LIMS resulting in failure to issue anti-D Ig within 72 hours	1
Total	**14**

Table 11.9: Technical errors n=10

Technical errors	Number of cases
Inappropriate use of electronic issue	9
Sample analysed, results not appearing in the authorisation queue in Winpath. Three emergency units taken from the transfusion laboratory. IT problem took approximately 30 minutes to resolve	1
Total	**10**

Table 11.10: Interpretation errors n=10

Interpretation errors	Number of cases
ABO/D grouping errors	5
Antibody identification results	1
Misinterpretation of fetomaternal haemorrhage (FMH) result leading to excessive dose of anti-D Ig being given	1
BMS misinterpreted the anti-D algorithm for repeat bleeding in pregnancy therefore anti-D Ig was not administered	1
Patient D typed incorrectly by Blood Service. D-positive initially, changed to treat as D-negative, anti-D Ig administration was delayed	1
Anti-D Ig inappropriately administered to a woman who had delivered a D-negative infant but the cord group incorrectly reported as D-positive following manual testing	1
Total	**10**

Case 2: Insufficient testing for antibody identification

A sample was received for crossmatching out-of-hours. The antibody screen was found to be positive and the antibody identification was concluded as 'irregular anti-human globulin (AHG)-reactive antibodies'. All clinically-significant antibodies on the identification panel were excluded by the homozygous expression of the antigen on test cells and unselected units compatible by indirect antiglobulin test (IAT) crossmatch were issued. Further investigation the following morning with an enzyme-treated cell panel identified anti-c. The enzyme panel is not routinely performed. Both units issued were retrospectively identified as R2r (cDE/cde).

Learning point

- Enzyme-treated cell panels are useful to detect Rh antibodies and can improve the chances of correctly identifying an antibody mixture. Enzyme-treated identification panels should be considered for routine use (Milkins et al. 2013)

Testing errors	Number of cases	Percentage of cases
Procedural errors	12	33.3%
Interpretation errors	8	22.2%
Transcription errors	6	16.7%
Equipment failure/testing problem	6	16.7%
Manual grouping errors	4	11.1%
Total	**36**	**100%**

Table 11.11: Near miss testing errors

IT and analyser-related near miss reports

Surprisingly in 2014 there were several reports of equipment failures leading to testing problems, n=6. All incidents were in separate Trusts/Health Boards and where stated different analysers were implicated. The issues can be summarised as:

- Two analysers mis-grouped samples, exact causes not known
- A sample with a known antibody was reported as antibody screen negative by two analysers in the same laboratory, but the antibody screen was positive on both analyser databases. The manufacturer has investigated the error and resolved it to the satisfaction of the Medicines and Healthcare products Regulatory Agency (MHRA) Medical Devices section
- A poorly printed barcode was misread by an analyser as a different number, so an incorrect grouping result was reported on another patient's record
- An incorrect group was transferred from the analyser to the laboratory information management system (LIMS) exact cause not known
- An initial suspected wrong blood in tube (WBIT) was determined to be a laboratory analysis error, probably IT related, but exact cause not known

Laboratories are increasingly reliant on IT. The UK Transfusion Laboratory Collaborative (UKTLC) minimum standards (Chaffe et al. 2014) recommend that all laboratories have complete walk-away automation which is in use 24 hours, 7 days a week. In the absence of complete automation, documented measures must be taken to mitigate procedural laboratory errors.

Learning point

- Laboratories should ensure all automated processes are fully validated and constantly monitored for accuracy. IT systems should be audited on a regular basis against the BCSH guidelines for the specification, implementation and management of IT systems in hospital transfusion laboratories (BCSH Jones et al. 2014)

Further IT errors are discussed in the relevant chapters.

Component selection errors n=39

A variety of component selection errors were reported including:

- Selecting the wrong component n=13 e.g. FFP when cryoprecipitate was requested
- Late/omitted or insufficient dose of anti-D Ig to women n=11
- Units that are not of the correct specification n=8 (i.e. not irradiated or of the correct phenotype)
- Selection of expired units n=6
- Selecting the wrong pack i.e. RBRP n=1

These component selection errors could have been prevented if laboratory staff maintained their understanding, knowledge and skills within the transfusion laboratory.

Learning point

- Regular participation or assessment within a continuing professional development (CPD) scheme is essential for all transfusion laboratory staff

Component labelling, availability and handling and storage errors n=109

Many cases in this category are due to labelling errors (n=50), where labels were transposed when more than 1 unit was issued to the same patient. In 44 cases expired units were not discarded but reissued to patients or cold chain errors occurred that resulted in units which had been out of controlled temperature being transfused to patients. The remaining 15 were:

- 12 cases related to availability of components
- 3 further labelling errors where the labels for 2 units that were intended for different patients were transposed

Miscellaneous n=4

There were 4 cases that did not result from errors in the transfusion process and are described below. All of these were due to lack of communication and lack of knowledge by laboratory staff.

Case 3: Omission of anti-D Ig treatment during D-mismatched human leucocyte antigen (HLA)-matched platelet transfusion

HLA-matched platelets were transfused to a patient on two occasions. The female patient (42 years) was D-negative and the platelets on both occasions were D-positive. No consideration was given to administration of anti-D Ig by laboratory or clinical staff at the time of transfusion.

Case 4: Inappropriate administration of anti-D Ig

A female patient with major haemorrhage required 4 units of FFP as part of the component replacement. The patient grouped as A D-negative and the BMS only had group A D-positive FFP available. The BMS wrongly thought that, as with platelets, anti-D Ig was required when transfusing mismatched D-grouped FFP to a woman of childbearing potential and informed the clinical staff. The patient was wrongly issued anti-D Ig by the laboratory which was then administered.

Case 5: Poor communication leads to delayed anti-D Ig administration

A BMS working on a Friday failed to fully follow the SOP in a timely manner. A female patient grouped as D-negative and as a result of poor handover the next BMS failed to issue anti-D Ig prophylaxis that night. This omission was not detected until after the weekend and so anti-D Ig was issued outside the 72-hour period following a sensitising event.

Case 6: Incomplete information transmitted from the Blood Service - communication failure

This case is described in Chapter 9 Serial Errors and Multiple Missed Opportunities to Detect an Earlier Error, Case 18.

Learning points and suggested actions

- Standardisation of laboratory reports so they cannot be misinterpreted
- Standardisation of patient records with electronic transfer of D-grouping results where possible

UK Transfusion Laboratory Collaborative (UKTLC)

The UKTLC recommendations as published in 2009 and updated in 2010 targeted a 50% reduction in laboratory related errors by September 2012 (Chaffe et al. 2010). The deadline for this target reduction coincided with an upsurge of pathology reorganisations designed to deliver the level of savings as outlined in the Carter review of 2008 (Lord Carter of Coles, 2008). The target incident reduction of 50% was not met and the move towards merging pathology services within Trusts/Health Boards and the formation of pathology networks has presented new challenges to achieving ongoing error reduction.

Pathology modernisation has seen the implementation of blood sciences departments across pathology networks where cross-trained BMS staff have provided the flexibility needed to provide 24/7 cover. However, integration of blood transfusion services into the blood sciences model within pathology networks is harder as, unlike the diagnostic nature of haematology and biochemistry services, blood transfusion is a therapeutic service requiring different skills. It is essential that blood transfusion services are included in the modernisation of pathology services in a manner that ensures the safety of the service at ALL times.

The UKTLC Standards 2014 have been published to help facilitate safe and effective integration while aiding the reduction of laboratory related errors.

Laboratory surveys undertaken in 2011 and 2013 both showed a reluctance by laboratories to implement the UKTLC recommendations as there was no formal requirement to do so. The data collected in 2014 clearly show that laboratory-related errors continue to occur at an unacceptably high rate and would appear to be increasing. These findings underpin the urgent need for laboratories to assess their service against the newly published UKTLC standards.

The UKTLC Standards 2014 are supported by the Clinical Pathology Accreditation, UK Accreditation Service and the Medicines and Healthcare products Regulatory Agency. The published new standards are available on both the SHOT and Institute of Biomedical Science (IBMS) websites by open access (Chaffe et al. 2014). The standards are divided into three sections, staffing, information technology, knowledge and skills. Each section is designed to encourage laboratories to adopt effective and appropriate practices in order to address incident reduction in a responsible and professional manner that recognises the current framework of legislative requirements as well as the absolute need to ensure that specialist knowledge is maintained within the local/network blood transfusion chain of practice at all times. To many the knowledge and skills requirement for the future will be the biggest challenge. Guidance on the implementation of standards relating to knowledge and skills will be available on the IBMS website.

COMMENTARY

The number of cases relating to sample receipt and registration, and testing errors highlight key areas, particularly lack of effective communication together with poor serological knowledge and understanding in laboratory staff. National guidelines define the minimum dataset required for samples and requests (BCSH Harris et al. 2009).

All ABO and D testing errors occurred as a result of manual interventions, such as transcription and interpretation. In addition to serological testing, historical laboratory records may influence the selection of the most appropriate components for the patient, so must be consulted and actioned.

Pathology services within the NHS are undergoing fundamental changes. The pressure of such changes are being cited as mitigating circumstances in a number of cases. These incidents raise concern in relation to laboratory staff shortages and pressures associated with heavy workload and distractions.

References

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

BCSH Jones J, Ashford P et al. (2014) **Guidelines for the specification, implementation and management of IT systems in hospital transfusion laboratories**. Transfus Med 24(6), 341-371
http://www.bcshguidelines.com/documents/IT_guidelinesAug14_final.pdf [accessed 10 March 2015]

BCSH Harris A M, Atterbury CLJ et al. (2009) **BCSH Guidelines on the administration of blood components**.
http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf [Accessed 30/03/2015]

Chaffe B, Jones J et al. (2010) **Recommended minimum standards for hospital transfusion laboratories – UK Transfusion Laboratory Collaborative**. The Biomedical Scientist 54(10), 711-712
http://www.ibms.org/go/practice-development/transfusion-laboratory-collaborative [Accessed 30/03/2015]

Chaffe B, Glencross H et al. UKTLC (2014) **UK Transfusion Laboratory Collaborative: Recommended Minimum Standards for Hospital Transfusion Laboratories**. Transfus Med 24(6): 335-340
http://onlinelibrary.wiley.com/doi/10.1111/tme.12153/full [Accessed 30/03/2015]

Department of Health (2008) **Report of the second phase of the review of NHS pathology services in England**. (Chaired by Lord Carter of Coles). London: DH [Accessed 15/05/2015]
http://webarchive.nationalarchives.gov.uk/20130107105354/http:/www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_091984.pdf

Summary of Errors Related to Information Technology (IT) n=236

12

Author: Megan Rowley

This chapter covers transfusion adverse events that relate to laboratory information management systems (LIMS) as well as other information technology (IT) systems and related equipment used in the delivery of hospital transfusion services.

Key SHOT messages

- Hospitals using electronic blood management systems should review the individual use of 'emergency' procedures used to bypass the built-in checks whether at the bedside or when collecting blood from the refrigerator. There should be immediate retraining of staff using the system incorrectly
- Hospitals should work with the manufacturer to develop safe and robust emergency protocols, which prevent blood delay but still provide full traceability and effective bedside 'right blood right patient' checks

The cases included are drawn from the other chapters of this report as shown in Table 12.1. Cases selected include events where IT systems may have:

- Caused or contributed to the errors reported
- Been used incorrectly
- Prevented errors but were not used

Where the corrective and preventative action suggested by hospitals in response to errors included IT solutions these have been included if they illustrate an important point.

In 2014 there were 236 (247 including anti-D errors) reported incidents of errors related to IT systems (Table 12.1). Breakdown of the 2013 numbers is shown for comparison: The increase in SRNM errors related to those where the primary error was outside the laboratory if it was considered that specific requirements might have been met if IT flags or alerts had been used in the laboratory. RBRP included any cases where incorrect data was recorded on one or more computer systems.

Error	2013	2014
Incorrect blood component transfused laboratory (IBCT-WCT)	8	15
Incorrect blood component transfused clinical (IBCT-WCT)		7
Specific requirements not met laboratory (SRNM)	36	49
Specific requirements not met clinical (SRNM)	81	79
Right blood right patient (RBRP)*	51	57
Avoidable, delayed and under-transfusion (ADU)	2	12
Handling and storage errors (HSE)	9	17
Total	**187**	**236**
Anti-D Ig errors	16	11
Total including anti-D	**203**	**247**

**the multiple incidents (n=273) related to the Haemonetics BloodTrack system are counted as one case*

Table 12.1: Source of cases containing errors related to IT

Table 12.2: Area of origin n=236

Area	Number of cases	%
Laboratory	104	44.1%
Clinical	132	55.9%
Total	**236**	**100%**

Table 12.3: Time of day where known n=151

Time by 24h clock	Number of cases	%
Core 08:00-20:00	117	77.5%
Out of hours 20:00-08:00	34	22.5%
Midnight onwards 00:00-08:00	16	10.6%
Total	**151**	**100%**

A total of 195/236 (82.3%) cases involved red cells, 20/236 (8.5%) involved platelets and 20/236 (8.5%) related to plasma components with an additional 11 due to anti-D immunoglobulin (Ig).

22/236 (9.3%) cases with IT errors occurred in children (8 were infants below the age of one year).

Where the urgency of the request was available 146/208 (70.2%) of the transfusions were considered routine, 47/208 (22.6%) urgent and 15/208 (7.2%) were emergencies. In 28 cases the urgency of the request was not stated.

Incorrect use of a bedside blood tracking system (273 units and 105 members of staff)

One hospital reported multiple failures of the 'right blood right patient' bedside check related to the incorrect use of a bedside tracking system and below is the report provided which explains the nature of the error.

A cause for concern – the hospital report January 2015 (included with permission from both the hospital and Haemonetics)

We have been using the BloodTrack SafeTx electronic system from Haemonetics for the past 5 years and we transfuse in the region of 35,000 units per annum. Using this system we have a traceability figure of 99.7% as opposed to 86% using a manual paper-based system.

A third of these transfusions are carried out using the EMERGENCY TRANSFUSION option, most of which are carried out in theatres and the emergency department (ED). The decision to use this option was made by these clinical areas primarily to avoid the need to record observation at each stage of the process, thus speeding up the procedure. Consideration has been given to removing the 'observations' option from the devices used in these specific areas but this would have caused problems when devices are swapped between different clinical areas.

When the emergency option is chosen, after scanning the patient's identification band, the user encounters the following screen:

At this juncture the screen asks the user to either

(a) scan the compatibility label which is attached to the units or

(b) '**Or Tap Here To Give Emergency Blood**' if using the **emergency O Rh D-negative blood** which of course does not have a compatibility label. When this second option is chosen, the built in 'right blood right patient' safety checks are quite correctly bypassed by the system.

Since February 2014 we have been auditing every single unit, which has been transfused using the EMERGENCY TRANSFUSION option, and these are the results.

Between February and October 2014 a total of 273 units (average of 30 units/month) were transfused using the wrong option whereby the 'right blood right patients' safety checks were bypassed in error. The user had not scanned the compatibility label as they should have, but instead had chosen the '**Or Tap Here To Give Emergency Blood**' option even though they were not using the emergency O D-negative. A total of 105 staff were involved.

An incident report was raised on each occasion and the member of staff involved was contacted by email. A one-to-one retraining session was conducted, where the potential gravity of their error was reinforced. There were no repeat offenders identified. The message is beginning to get through, since the numbers for November and December 2014 are encouraging. Only 2 units were transfused using the incorrect option in November, and 13 units in December. This error occurs both when only 1-2 units are given and when multiple units are given i.e. major haemorrhage.

The company (Haemonetics) has acknowledged this potential weak link in an otherwise very safe system, and has made assurances that it will be rectified in the next software version due in June 2015. In the meantime we intend to continue with our present policy of raising an incident report and conducting one-to-ones with the individuals concerned, every time it happens.

Electronic blood tracking systems are designed to reduce human error at the bedside. However, all staff must be trained to use the system safely and in the manner for which it was intended. The Emergency Blood option was intended for emergency group O units that did not have a compatibility label attached to them but in this situation it was used to avoid having to enter observations because they were being recorded elsewhere.

COMMENTARY

As noted above the company has responded to this incident (and an additional report from a different hospital). They note that 'the Emergency Transfusion protocol is meant to be faster and only meant to be used for emergency situations. It removes completion of configuration checklists and removes entering of vital signs. By using the '**or tap here to give emergency blood**' button the user is telling BloodTrack Tx that there is no compatibility label to scan and that the unit is an uncrossmatched unit. Use of this process for non-emergency transfusions is misuse resulting in bypassing the important safety step of checking that the unit is actually intended for the patient'. The company have taken the following actions:

- Root cause analysis of the incident above
- Review other sites to determine whether this issue is occurring elsewhere
- Sent an advisory letter to all customers reminding them of correct use and confirmation of the next release of software which will include enhancements to the Emergency Blood protocol

Deaths

There were no transfusion-related deaths where IT systems contributed.

Potential for major morbidity

There were two cases with potential for major morbidity due to alloimmunisation in women of childbearing potential.

Major and minor morbidity

There were no cases where IT systems contributed to major or minor morbidity

There were 4 cases where incorrect use of IT systems contributed to alloimmunisation but with no haemolytic transfusion reaction.

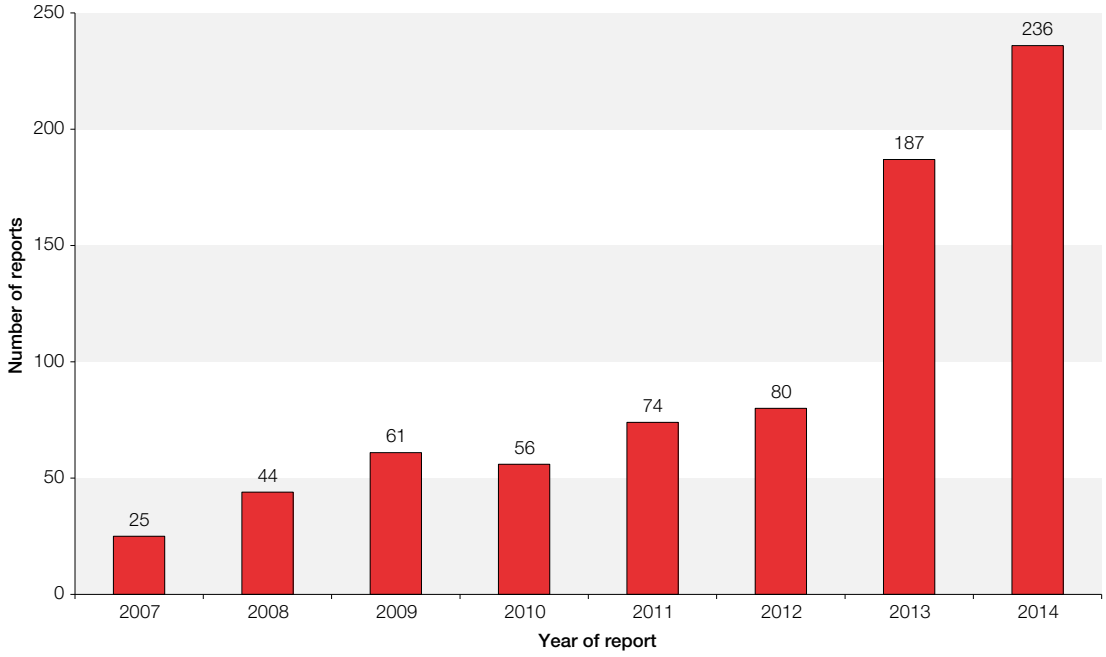
No harm

All the other cases did not result in any harm to the recipient of the components transfused.

COMMENTARY

An increasing number of cases are reported each year where the use or misuse of IT systems played a part (Figure 12.1). These are more often caused by human factors, such as inappropriate set up and work-arounds, as in the RBRP cases where set up of the IT system permitted use of the emergency button for routine transfusions, or by overriding flags or not setting them up in the first place. Cases of IT malfunction are, by contrast, very rare. However it is essential that users work closely with developers of any IT system to remove design faults before these translate into system faults and incidents of potential or actual harm.

Figure 12.1: IT cases 2007-2014



Anti-D Immunoglobulin: Prescription, Administration and Sensitisation

13

Author: Tony Davies

Definition:

An adverse event relating to anti-D immunoglobulin (Ig) is defined as relating 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 message

- SHOT's key message in relation to the use of anti-D Ig has always been to encourage consistency of practice within hospitals, with robust policy formulated as a collaboration between obstetricians, midwives and the laboratory, regardless of which professional guideline may influence the detail

Anti-D administration errors summary n=359

(full details are available in the 2014 Annual SHOT Report: Web Edition)

A total of 359 case reports were reviewed this year, of which 273 (76.0%) 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 were 3 cases where a woman developed an immune anti-D following delay or omission of prophylaxis during the current pregnancy.

There was one case where immune anti-D was wrongly assumed to be prophylactic and so the pregnancy continued unmonitored, resulting in a severe case of haemolytic disease of the fetus and newborn (HDFN) requiring intensive transfusion support.

Persistent 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 is a culture of transcribing blood grouping results onto maternity notes and care plans, resulting in omission or inappropriate administration of anti-D Ig
- Laboratories who do not utilise their automation and laboratory information management systems (LIMS) fully for the issue of anti-D Ig, with errors relating to manual interventions and input
- Misinterpretation of the Kleihauer test in the laboratory, resulting in an incorrect initial dose of anti-D Ig being issued
- 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

There are however two examples of implementation of good practice following reported errors, and these are to be applauded and highlighted:

Case 1: Laboratory report misinterpreted

Anti-D Ig was issued from clinical stock for a post-natal woman, after staff misinterpreted 'Antibody Screen Negative' as 'D-negative'. The ward procedure has been changed to ensure a check of grouping results by two people before treatment decisions are taken.

Case 2: Transcription of blood groups is dangerous

Anti-D Ig was administered in a private clinic by a consultant, following the incorrect manual entering of the woman's blood group by a clerk onto the clinic computer. The consultant has insisted on sight of validated laboratory reports prior to issuing anti-D Ig in the future.

SHOT Anti-D Sensitisation Study n=66

Author: Jane Keidan

Key SHOT messages

- Immunisation to the D antigen in women of childbearing potential continues to occur and can cause significant morbidity in future pregnancies and possible fetal mortality

  Therefore:

  - All cases of anti-D immunisation detected for the first time in pregnancy should be reported to SHOT
  - SHOT will ensure reporters are reminded to submit a full dataset after delivery
- Deficiencies in management of potentially sensitising events indicate inadequate knowledge among healthcare professionals (medical, midwifery, laboratory) and also the women themselves who fail to seek advice
  - All healthcare professionals involved in the issue and administration of anti-D Ig should complete the anti-D modules in the Learn Blood Transfusion e-learning programme to maintain up to date knowledge of standards for management of D-negative pregnancies and understand the rationale behind it
  - All departments involved in the issue and administration of anti-D Ig should develop a flow chart or checklist reflecting national guidance to ensure that an appropriate dose of anti-D Ig is issued and administered (an example is available at www.shotuk.org under resources)
  - D-negative women must receive information at an early stage of pregnancy to ensure they seek medical advice after potentially sensitising events and are empowered to question their management

Introduction

Despite antenatal and postpartum anti-D Ig prophylaxis, ancedotally we know that sensitisation to the D antigen is still occurring, even though nationally there is no systematic process for collecting these data. Anti-D immunisation may occur due to errors in management of potentially sensitising events (PSE) in pregnancy (reportable to SHOT). However, SHOT rarely receives follow-up data on women where an error in anti-D Ig administration has been reported, so the clinical signficance of these errors is unknown. The introduction of routine antenatal anti-D Ig propyhylaxis (RAADP) (NICE 2008) was predicted to further reduce anti-D sensitisation rates, but recent concerns have been raised around the adequacy of intramuscular anti-D Ig dosage in obese women, and there are questions on the management of anti-D Ig prophylaxis in women whose pregnancy continues beyond 40 weeks.

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. Reporters are requested to provide data on booking weight, management of sensitising events during pregnancy and the administration of routine anti-D Ig prophylaxis, both in the index pregnancy and the pregnancy immediately before the index pregnancy (if applicable).

Results

The data will be presented cumulatively each year, as it will only be possible to draw robust conclusions once a sufficient number of cases have accrued. To the end of 2014 a total of 66 cases have been reported, although some are incomplete.

- 16 cases occurred women with no previous pregnancies (NPP)
- 50 cases occurred in women with previous pregnancies (PP)

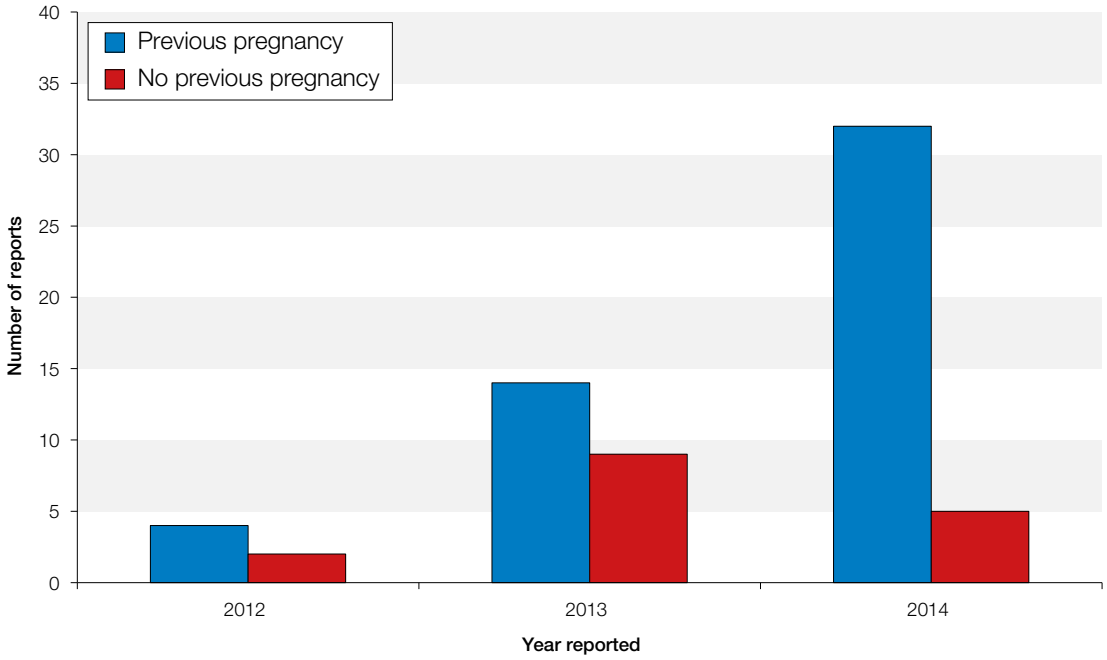


Figure 13.1: Number of reports of anti-D immunisation in pregnancy by year, 2012-2014

No previous pregnancy (NPP) n=16

When immune anti-D was detected	Number of cases
Before 28 weeks	6*
At delivery at 26 weeks	1
After 36 weeks	9
Total	**16**

**all received RAADP before the result showing immune anti-D was available*

Table 13.1: When was the immune anti-D detected?

Weight at booking in Kg	Number of cases
<68	8
68-80	3
>80 (obese)	2
No information	3
Total	**16**

Table 13.2: What was the booking weight?

Table 13.3: Did the women receive appropriate RAADP?

RAADP regimen (anti-D Ig dose)	Number of cases
Single dose 1500IU at 28 weeks	14
Two dose regimen 500IU	1
Delivered before 28 weeks (not given)	1
Total	**16**

The route was specified in 3 cases and was intramuscular (2 deltoid), as this data was only asked for in 2014.

Table 13.4: Details of potentially sensitising events (PSE) n=6 (4 women had 6 events)

PSE	Number of cases	Management
Antepartum haemorrhage (APH)	3	2 appropriate including Kleihauer and anti-D Ig within 24 hours 1 unreported by woman
Interventions (chorionic villus sample, amniocentesis)	2	2 appropriate including Kleihauer and anti-D Ig within 24 hours
Fall	1	Presented to out-of-hours GP, no anti-D Ig given
Total	**6**	

Two of 6 cases did not receive correct management for PSE.

Pregnancy outcomes

All pregnancies resulted in live births: 10 had no complications, 4 babies required phototherapy and 1 case required exchange transfusion. (No details given in one case).

Summary

- **In 7 cases, sensitisation had occurred before RAADP administration but in only 3 of these were prior potentially sensitising events documented**. In one case the event immediately preceded delivery at 28 weeks, in the other two cases sensitising events occurred but the women did not receive prophylactic anti-D Ig, in one case because the event was not notified by the woman, in the other due to incorrect medical management
- **In 9 cases sensitisation occurred later in pregnancy (after 36 weeks) when RAADP had been given**. Two of these 9 cases had grossly elevated body mass index (BMI). In two cases PSE had occurred earlier in the pregnancy but had been correctly managed

Previous pregnancies (PP) n=50

Table 13.5: When was the anti-D detected?

Time of anti-D detection	Number of cases	
At booking	26	
During pregnancy	17	
At term	5	
Other	2	
Preoperative assessment following pregnancy		*1*
At planned follow up of large fetomaternal haemorrhage at delivery where correct dose of anti-D Ig had been given		*1*
Total	**50**	

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 on pregnancy immediately preceding index pregnancy

In 7 cases, the previous pregnancy ended in termination or miscarriage, leaving 43 previous pregnancies that went to term.

Weight at booking in Kg	Number of cases
<68	18
68-80	5
>80 (obese)	6
No information	14
Total	**43**

Table 13.6: What was the booking weight? n=43

Anti-D Ig prophylaxis	Number of cases	Detection of immune anti-D in index pregnancy
Appropriate anti-D Ig received	3	2 at 28 weeks and 1 at term
No information about prophylaxis	4	3 early detection of anti-D in index pregnancy; at 8, 9 and 14 weeks
Total	**7**	

Table 13.7: Did the women receive appropriate anti-D Ig prophylaxis for pregnancy loss? n=7

RAADP	Number of cases
Single dose	28
Two doses	3
Not given	11
No information	1
Total	**43**

Table 13.8: Did the women who carried to term receive RAADP? n=43

11 of 43 cases did not receive RAADP.

Reasons for non administration of RAADP included learning difficulties, concealed pregnancy, needle phobic, prior to RAADP introduction, delivered abroad (3), no reason given (4).

Type of event	Number of PSE	Management
APH	5	1 managed correctly (40 weeks gestation) 1 given anti-D Ig but no Kleihauer (26 weeks) 3 no anti-D Ig given (12 weeks,16 weeks, unknown)
Falls	3	2 managed correctly 1 not reported by woman
External cephalic version	1	Managed correctly
Total	**9**	

Table 13.9: Details of potentially sensitising events n=9

5 of 9 cases did not receive correct management for PSE.

Type	Number of cases
No information	19
Vaginal	16
Instrumental	2
Elective caesarean section (CS)	2
Emergency CS	4
Total	**43**

Table 13.10: Method of delivery n=43

Table 13.11: Postpartum prophylaxis n=43

What happened?	Number of cases
Kleihauer test and appropriate dose of anti-D Ig including 4 cases requiring higher doses as a result	31
No prophylaxis (2 from overseas, 1 learning difficulties)	3
Incorrect dose of anti-D Ig (1 dose 250IU, 1 dose given late)	2
No information	5
D-negative baby	2
Total	**43**

Gestation >40 weeks

No data collected in current questionnaire but we plan to add this question in future.

Anti-D detected at booking of index pregnancy n=26

The details of the preceding pregnancy may provide information on the 'cause' of immunisation in these cases, 24/26 of these went to term

Table 13.12: Details of preceding pregnancy where available

Details	Management notes
8 cases had 'ideal care'	Correct RAADP and postpartum prophylaxis, not obese and no known PSEs
3 cases no RAADP given	1 learning difficulties,1 termination,1 miscarriage
PSEs n=8 cases	
3 APH	*2 cases no anti-D Ig given, 1 case no Kleihauer*
3 falls	*2 received appropriate prophylaxis, 1 not reported by woman*
1 termination	*Did not receive appropriate prophylaxis*
1 miscarriage	*Did not receive appropriate prophylaxis*
10 cases had delivery method specified	6 vaginal 2 instrumental 2 CS (1 elective, 1 emergency)
Postpartum anti-D Ig	
19	Correct dose, Kleihauer performed
2	Not given: learning difficulties, D-negative baby
3	No information

Anti-D detected later in index pregnancy n=22

Further information was 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.

Table 13.13: What was the booking weight? n=22

Weight at booking in Kg	Number of cases
<68	9
68-80	6
>80	0
No information	7
Total	**22**

Table 13.14: RAADP in current pregnancy n=22

RAADP given or not	Number of cases
Single dose 1500IU	14
Not given:	8
No reason given	*4*
Needle phobia	*1*
Late booker	*1*
On advice of Blood Service	*1*
Incorrectly typed as D+ in past	*1*

Sensitising events in current pregnancy occurred in 2 women:

- One unreported fall at 21 weeks
- One unreported APH at 8 weeks

Neither received anti-D Ig prophylaxis.

Outcome	Number of cases
Live births	19
Required phototherapy	*6*
Required exchange transfusion	*1*
Miscarriage	2
Termination	2
Ectopic	1
No information available	26
Total	**50**

Table 13.15: Overall outcomes n=50

Summary

- In 26 cases, sensitisation presumably occurred during a previous pregnancy as anti-D was detected at booking in the index pregnancy, and in 8 of these no risks for immunisation were identified
- In 22 cases sensitisation occurred later in pregnancy so that the relative contribution of previous pregnancies is less clear, but analysis of the index pregnancy identifies failures in management, particularly omission of RAADP and unreported potentially sensitising events

COMMENTARY

The dataset is at a preliminary stage and relies heavily on a full report being completed in each case. There are many gaps in the data, as it is likely that reporters are opening a file when anti-D is detected in the index pregnancy but not completing the dataset once delivery has occurred. SHOT is now setting up a robust reminder system.

The 16 women with no previous pregnancies (NPP) raise important questions on the efficacy of current prophylactic anti-D Ig policies: 7 women had developed anti-D before RAADP was due and in only 3 of these was there a prior identifiable sensitising event. One of these women failed to seek medical advice and thus did not receive appropriate prophylaxis, and one was managed incorrectly by medical staff. In the third case the event occurred immediately prior to delivery at 28 weeks. In the 9 NPP women who developed anti-D later in pregnancy, all received RAADP but data on route of administration is not available. Two cases had grossly elevated BMI, 2 others had sensitising events that were correctly managed, leaving 5 cases with no identifiable 'risk factors' for immunisation.

In women who had had a previous pregnancy (PP), the data show deficiencies in care, which may have lead to immunisation in the index pregnancy, but not in every case. Indeed, in 8 cases the management of anti-D Ig prophylaxis in the preceding pregnancy was 'ideal' with no obvious risk factors for immunisation, demonstrating that use of prophylactic anti-D Ig in accordance with current guidance does not prevent immunisation in every case.

There have been previous reports of immunisation to the D antigen in pregnancy despite apparently 'ideal' management (Amirthanayagam and Regan 2012). Recent unpublished cases of failure of RAADP in obese women led to revision of the summary of product characteristics for Rhophylac (CSL Behring) and an amendment to British Committee for Standards in Haematology anti-D Ig guidelines in 2014 (BCSH 2014). Despite the very preliminary nature of the SHOT immunisation data, they do raise concerns not only around awareness of correct prophylactic procedures among medical and midwifery staff and the women themselves, but also about the efficacy of the currently recommended prophylactic anti-D Ig regimens (BCSH Qureshi et al. 2014).

References

Amirthanayagam A and Regan F (2012) **Why is anti-D sensitization still happening in women of child-bearing age?** Transfus Med 23, Suppl 2, 60-61

BCSH Qureshi H, Massey E et al. (2014) **Guideline for the use of anti-D immunoglobin for the prevention of haemolytic disease of the fetus and newborn**. Transfus Med 24(1), 8-20

BCSH (2014) **Prophylactic anti-D immunoglobulin 2014-amendment**. http://www.bcshguidelines.com/documents/BCSH_Anti_D_guidelines_-__Amendment_4_8_14_(2).pdf [Accessed 23/04/2015]

National Institute of Clinical Excellence (NICE). (2008). **Routine antenatal anti-D prophylaxis for women who are rhesus D-negative**. Technology Appraisal Guidance No. 156 https://www.nice.org.uk/guidance/ta156

Reactions in Patients

14 Acute Transfusion Reactions (ATR) n=343

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 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. However, the possibility that a reaction could belong to one of these serious reaction categories must be kept in mind during recognition, initial assessment and treatment.

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). In the SHOT category of ATR the following reactions are included:

- Anaphylaxis / hypersensitivity
- Febrile non-haemolytic reactions (FNHTR)

Key SHOT messages

- The treatment of reactions and management of subsequent transfusions should be directed by recognised guidelines e.g. the British Committee for Standards in Haematology (BCSH) Guidelines on the investigation and management of acute transfusion reactions (BCSH Tinegate et al. 2012)
- SHOT has a role in identifying trends in reactions and events, including the monitoring of new components. If reactions are related to washed red cells or platelets in additive solution (PAS) (60-70%), or the forthcoming component 'washed platelets (100% PAS)' the reporter should indicate this on the appropriate implicated red cell or platelet component question

Introduction

There were 343 acute transfusion reactions analysed. The reactions included in this analysis are 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 are summarised below in Table 14.1, available online (ISBT/IHN 2011) and which have been adopted by the British Committee for Standards in Haematology (BCSH) (BCSH Tinegate et al. 2012).

	1 = Mild	2 = Moderate	3 = Severe
Febrile type reaction	A temperature ≥38°C and a rise between 1and 2°C from pretransfusion values, but no other symptoms/signs	A rise in temperature of 2°C or more, or fever 39°C or over and/or rigors, chills, other inflammatory symptoms/signs such as myalgia or nausea which precipitate stopping the transfusion	A rise in temperature of 2°C or more, and/or rigors, chills, or fever 39°C or over, or other inflammatory symptoms/signs such as myalgia or nausea which precipitate stopping the transfusion, prompt medical review AND/OR directly results in, or prolongs hospital stay.
Allergic type reaction	Transient flushing, urticaria or rash	Wheeze or angioedema with or without flushing/urticaria/ rash but without respiratory compromise or hypotension	Bronchospasm, stridor, angioedema or circulatory problems which require urgent medical intervention AND/OR, directly result in or prolong hospital stay, or Anaphylaxis (severe, life-threatening, generalised or systemic hypersensitivity reaction with rapidly developing airway and/or breathing and/or circulation problems, usually associated with skin and mucosal changes
Reaction with both allergic and febrile features	Features of mild febrile and mild allergic reactions	Features of both allergic and febrile reactions, at least one of which is in the moderate category.	Features of both allergic and febrile reactions, at least one of which is in the severe category.
Hypotensive reaction		Isolated fall in systolic blood pressure of 30 mm or more occurring during or within one hour of completing transfusion and a systolic blood pressure 80 mm. or less in the absence of allergic or anaphylactic symptoms. No/minor intervention required.	Hypotension, as previously defined, leading to shock (e.g., acidaemia, impairment of vital organ function) without allergic or inflammatory symptoms. Urgent medical intervention required.

Table 14.1: Classification of reactions

Types of reactions

Reactions have been classified as follows:

	Moderate	Severe	Total
Febrile	117	27	**144**
Allergic	81	58*	**139**
Mixed allergic/febrile	16	9	**25**
Hypotensive	4	0	**4**
Unclassified	21	10	**31**
Total	**239**	**104**	**343**

**Anaphylactic/severe allergic*

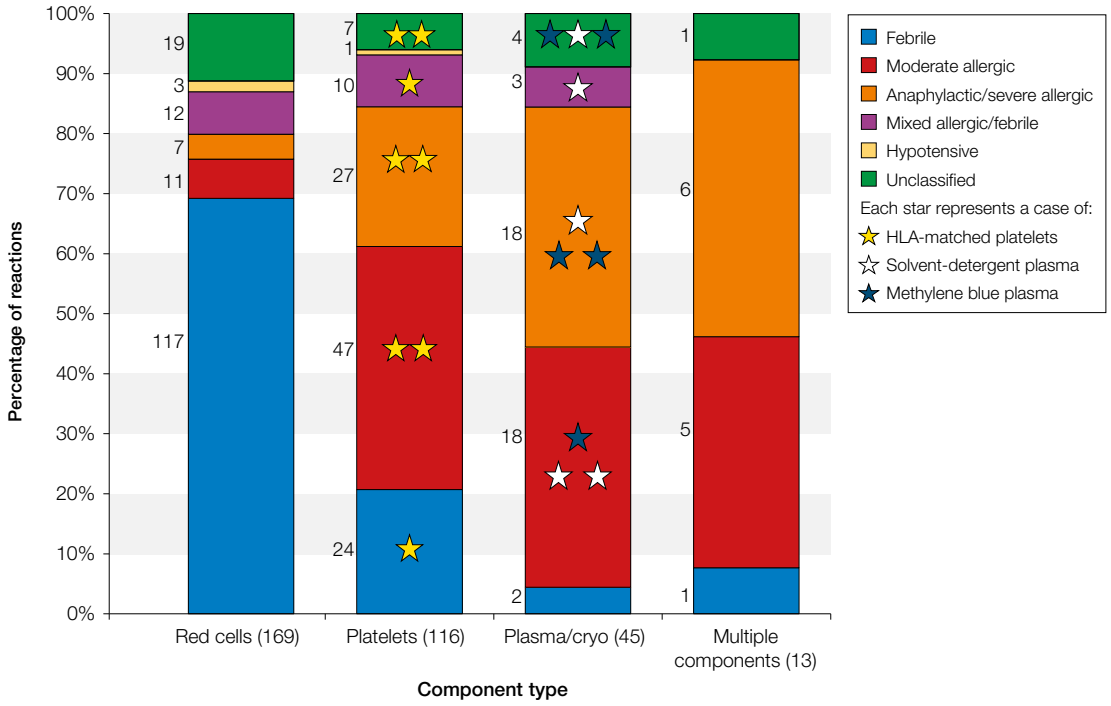
Table 14.2: Types of reactions

Comparison with previous reports

Similarities

The pattern of reactions remains similar to previous reports, Figure 14.1: Reactions by component type. Red cells are usually associated with febrile type reactions (~70%), plasma (including methylene blue-treated fresh frozen plasma (MB-FFP) and solvent detergent-treated FFP (SD-FFP)) with allergic reactions (~80%) and platelets cause more allergic (~60%) than febrile type (~20%) reactions but the percentage difference is less marked. 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 associated with the patient's underlying condition.

Figure 14.1: Reaction by component type



Analysis of reactions also remains comparable in the following:

Table 14.3: Characteristics of ATR

Characteristic	Occurrence
Age distribution	~90% 18 years or over and 1-2% 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% on wards

Differences

There has been a progressive change in the last few years in the percentage of reactions associated with each blood component, Figure 14.2. This is likely to reflect discontinuation of data collection for mild reactions, a reduction in red cell use and increase in platelet and plasma use over this time period. The number of cases associated with either MB-FFP or SD-FFP has also increased (10 in 2014, 4 in 2013) which may be related to their increased use (see Chapter 20 Paediatric cases for discussion of MB-FFP cases) but the numbers are small. In addition there has been a steady increase in the number and percentage of cases considered to be severe (104 in 2014, 66 in 2013) Figure 14.3. This may represent an alteration in reporting, changes in the definition of reaction severity or a modification in the method used to analyse and classify these reactions.

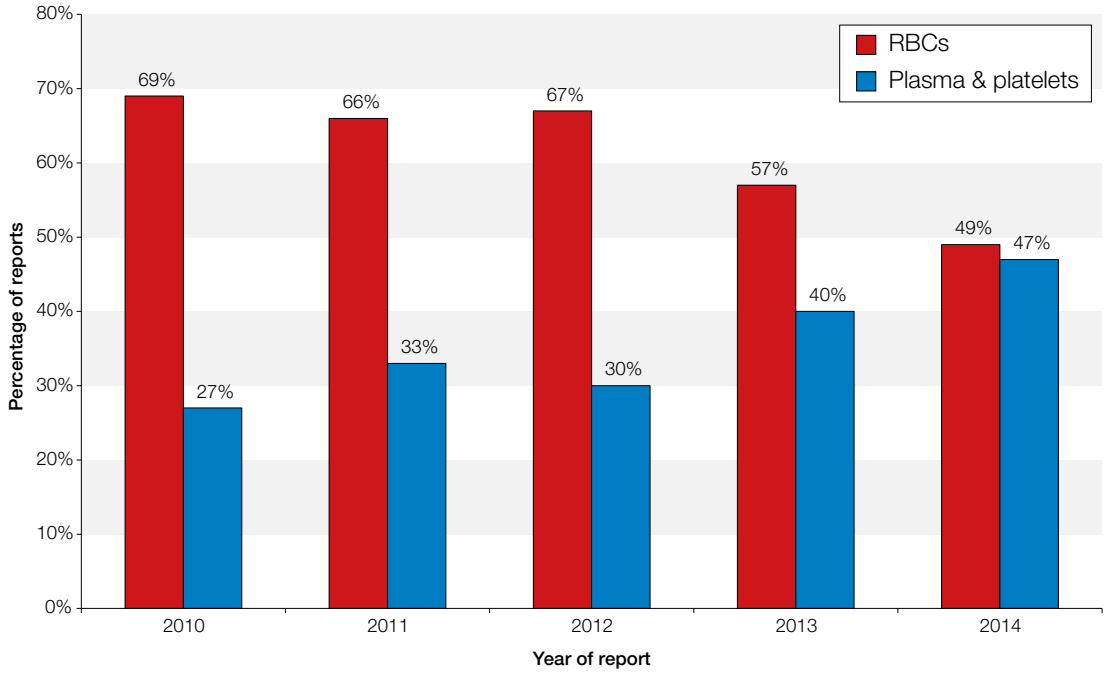


Figure 14.2: Percentage of total cases reported by component, excluding multiple components (2014 actual numbers can be found in Figure 14.1)

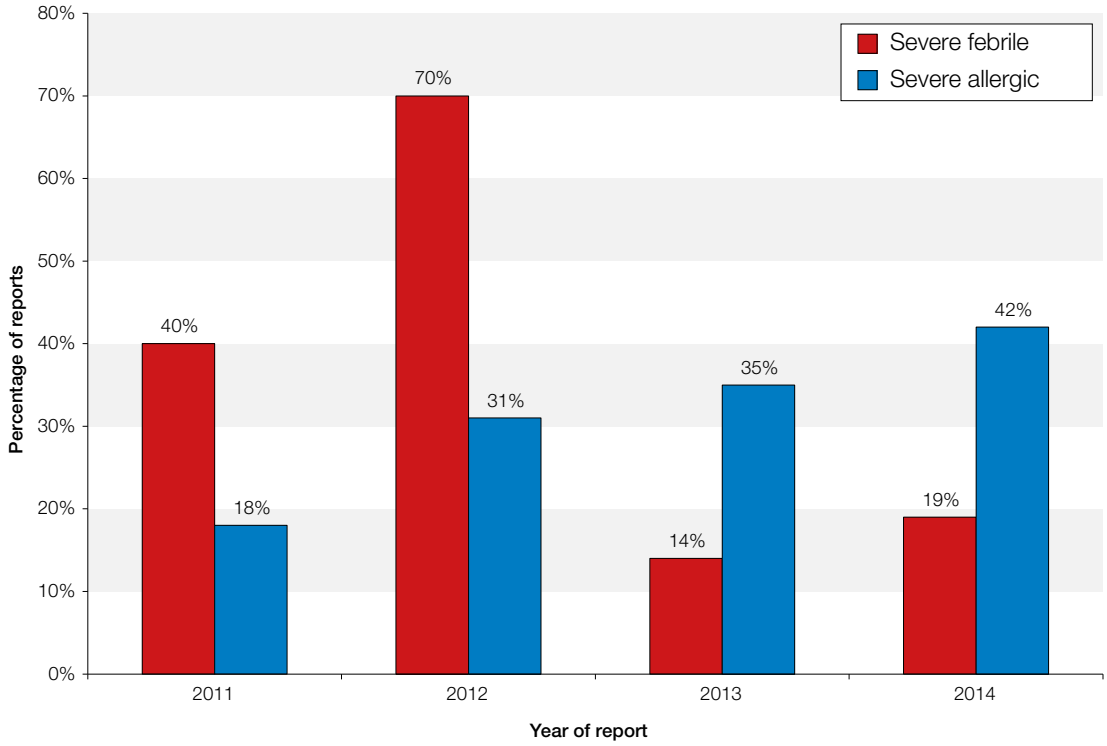


Figure 14.3: Percentage of total cases classified as severe (2014 actual numbers can be found in Table 14.2)

Recognition of reactions and their treatment, and management of subsequent transfusions

The recognition of reactions and their treatment and the management of subsequent transfusion episodes is considered this year, an analysis not performed in previous years.

Recognition of reactions

Continuous monitoring or routine transfusion observations identified most of the reactions. However in 122/343 (35.6%) cases patients themselves alerted staff promptly and in 13 cases this was done by relatives. In at least 10 cases rapid action by staff was felt to have curtailed the reaction severity. Good awareness of reactions by patients, relatives and staff therefore enabled rapid intervention and management which may have limited the severity and hastened recovery.

Treatment of reactions

In 97/144 (67.4%) of cases where symptoms were limited to a febrile type reaction, medication was given. However, in 42/97 (43.3%) of these this included an antihistamine +/- steroid, which is recognised treatment for an allergic but not a febrile type reaction.

In 112/139 (80.6%) of cases where symptoms were limited to an allergic reaction, medication was given. 14/112 (12.5%) of these included use of an antipyretic such as paracetamol as well as an antihistamine +/- steroid.

Management of subsequent reactions

There were 92 reports which stated that intervention for subsequent transfusions would be used. The most frequent intervention recommended was to use prophylaxis (52/92, [56.5%] of reports), usually with both an antihistamine and a steroid. This included at least 9/24 (37.5%) in which only febrile type symptoms had been reported.

Washed red cells and/or platelets in additive solution were planned for future transfusion in 22/92 (23.9%) and in 6 cases human leucocyte antigen (HLA)-matched platelets were documented to be required. In only one case where HLA-matched platelets were intended was this because of platelet refractoriness. In 5 cases where reactions occurred during plasma exchange, all of which were associated with SD-FFP, a decision was made to change to standard plasma in three, albumin in one, and to abandon procedures in another.

Five reports stated that subsequent platelet transfusions would be with apheresis rather than pooled platelets and three reports mentioned use of a manual rather than electronic crossmatch of red cells, although there was no evidence of haemolysis or red cell antibody formation.

Comment: Treatment with an antihistamine +/- steroid is commonly used for febrile type reactions but is not appropriate. HLA-matched platelets compared to standard platelets are unlikely to reduce reactions and should primarily be used when there is evidence of refractoriness. Similarly decisions to use apheresis rather than pooled platelets to prevent reactions, and manual rather than electronic red cell crossmatch, without haemolysis, are irrational and not evidence-based (BCSH Tinegate et al. 2012).

Illustrative cases

Case 1: Severe febrile reaction

A patient with myeloma, who also had dementia, had a 2 unit transfusion of irradiated red cells. The cannula needed reinserting during the second unit, and during this procedure the patient became very agitated, appeared cyanosed, and began shaking vigorously. She became dyspnoeic and had a slight rise in temperature. She was treated with antihistamine, hydrocortisone and given 100% oxygen. Her symptoms settled after 15 minutes.

Case 2: Repeated allergic reactions from different donors

An adult patient requiring regular platelet transfusions experienced allergic reactions with itch, chest and throat tightness, and mild wheeze, on three successive occasions. No cause was found. Two of these reactions, occurring 10 weeks apart, were reported to SHOT. On the first occasion, the implicated donor was removed from the HLA-matching panel, though this is not required, as it may not recur in that or any other recipient.

HLA-matching would not alter the risk of allergic reactions to platelets.

Cases 3 and 4: Allergic reactions to platelets from the same donation in two different recipients

Two young women were given prophylactic apheresis platelets from the same donor in an outpatient department on the same day. Case 3 experienced a moderate allergic reaction with chest tightness and shortness of breath 10 minutes after the transfusion had finished. Case 4 returned to the department 3 hours after transfusion with an itchy rash on her abdomen and back. Both were given intravenous (IV) chlorphenamine with good effect and discharged home later the same day. Subsequently 9 out of 11 further platelet concentrates from this donor were traced and none of the recipients had experienced a transfusion reaction.

Case 5: Severe allergic reaction associated with inappropriate transfusion

An adult male patient experienced a severe reaction within seconds of starting a unit of FFP, which was being given for warfarin reversal with a life-threatening bleed. Symptoms included chest pain and tightness, dyspnoea with wheeze, and angioedema. The FFP was given in the radiology department, and he had previously received IV contrast medium. No cause for the reaction was demonstrated.

The reporter noted that transfusion of FFP was inappropriate, as prothrombin complex concentrate was available and is the treatment of choice in this clinical setting.

Case 6: Anaphylactic reaction with characteristic mast cell tryptase response

A young male patient who was bleeding from a stabbing injury was given three units of red cells, four units of MB-FFP, and two units of cryoprecipitate, as part of a massive transfusion. During transfusion of one of the units of cryoprecipitate, he developed itch, urticaria, tachycardia and hypotension. Serial mast cell tryptase measurements were performed. The immediate and 12 hour samples were normal, at 7 and 12.1ng/mL while the 3 hour specimen was raised at 30ng/mL, in keeping with anaphylaxis.

References

BCSH Tinegate H, Birchall J, et al. (2012) **Guideline on the investigation and management of acute transfusion reactions. Prepared by the BCSH Blood Transfusion Task Force**. *Br J Haematol* **159**(2),143-153

ISBT/IHN, Haemovigilance Working Party of the ISBT (2011) **Proposed standard definitions for surveillance of non-infectious adverse transfusion reactions**.
http://www.ihn-org.com/wp-content/uploads/2011/06/ISBT-definitions-for-non-infectious-transfusion-reactions.pdf
[Accessed 30/03/2015]

NHSBT 2014 **Histocompatibility and Immunogenetics diagnostic services user guide**.
http://hospital.blood.co.uk/media/27385/inf136.pdf [Accessed 01/04/2015]

Resuscitation Council (2008) **Emergency treatment of anaphylactic reactions**.
http://www.resus.org.uk/pages/reaction.pdf. [Accessed 30/03/2015]

15 Haemolytic Transfusion Reactions (HTR) n=46

Author: Clare Milkins

Definition:

Acute haemolytic transfusion reactions (AHTRs) 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 (DHTRs) 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) may be reported in the Alloimmunisation category.

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).

The following HTR are included in this requirement: 'immunological haemolysis due to ABO incompatibility' (reported in Chapter 9 Incorrect Blood Component Transfused (IBCT)), and 'immunological haemolysis due to other alloantibody' reported in this chapter.

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
- There were no clinical symptoms associated with delayed haemolytic transfusion reactions in 50% of reported cases, making it the responsibility of transfusion laboratory staff to recognise laboratory signs that a reaction may have occurred. Laboratory staff should consider the possibility of a haemolytic transfusion reaction if there are any laboratory signs of haemolysis, development of new antibodies, or equivocal serological reactions within 4 weeks of a transfusion. Investigation should include a DAT, an eluate, and testing using additional techniques, e.g. enzyme or enzyme indirect antiglobulin test (IAT) panels, before further transfusions are given, unless the urgency of the transfusion requires concessionary release
- There is a huge variety of clinical symptoms associated with acute haemolytic reactions, and haemolysis may not be easy to confirm, particularly when the transfusion has been stopped after the transfusion of a small volume. Pre-transfusion serology should be repeated with a new sample, and an IAT crossmatch should be included where the red cells were provided by electronic issue. Investigation should include a DAT, and an eluate if the DAT is positive or if the serological picture is different from the original testing

- Anti-A or anti-B present in high dose intravenous immunoglobulin (IVIg) has been implicated in HTRs in non group O patients. Although these are usually mild reactions that may go unnoticed, rarely, the haemolysis can be severe, resulting in major morbidity. Blood transfusion laboratories should be made aware that patients are receiving high dose IVIg so that they can be vigilant for signs of haemolysis. All complications of IVIg infusion should be reported to the MHRA via the yellow card reporting system, although transfusion-related reactions should also be reported to SHOT

Number of cases

A total of 46 cases have been included, 18 acute and 28 delayed reactions.

Age range and median

There was one paediatric case this year (age 8 years). The overall age range was 8 to 97, with a median age of 64 years.

Deaths n=1

There were 3 deaths in total. In 2 cases the patient died due to their underlying disease, but in one case the haemolytic transfusion reaction definitely contributed to the patient's death (imputability 3).

Case 1: AHTR in very sick patient contributes to death

A patient was admitted to the intensive therapy unit (ITU) with drug-induced pneumonitis. The Blood Service reference laboratory reported allo anti-C plus strongly reactive autoantibodies, with a positive DAT, and provided R_2R_2 (cDE/cDE) K-negative red cells as suitable for transfusion. The first unit was transfused with IVIg and steroid cover, but 30 minutes after completion, the patient became agitated, flushed, tachypnoeic and wheezy, and developed haemoglobinuria, but then settled. Four and a half hours after completion of the unit, the patient deteriorated with decreased urine output; she suffered a cardiac arrest during intubation and died two hours later. Post transfusion her plasma was grossly haemolysed and the bilirubin had risen from 16 to 71micromol/L. The post mortem report cited the primary cause of death as multi-organ failure, HTR and pulmonary fibrosis, with a secondary cause of ischaemic heart disease. The contribution of the HTR to the patient's death was confirmed by the coroner. The most likely explanation for the HTR is exacerbation of the autoantibody by transfusion.

Major morbidity n=5

There were 5 cases of major morbidity. Three involved patients with sickle cell disease, two due to confirmed and one potential hyperhaemolysis, involving life-threatening falls in Hb, with one requiring ITU admission. One patient developed multiple antibodies 6 days post massive transfusion and required ITU admission, and another developed renal impairment following development of anti-Jk^a (Case 2).

Case 2: Anti-Jk^a of donor origin post haemopoietic stem cell transplant (HSCT)

A patient with acute myeloid leukaemia (AML) was 9/12 post HSCT, with graft versus host disease (GvHD) and receiving regular transfusions. Within an hour of starting the first unit, the patient developed rigors and back pain, was hypotensive and passed red urine. The pre-transfusion Hb of 69g/L fell to 43g/L post reaction, suggesting haemolysis of the patient's circulating red cells in addition to those just transfused. The patient had received 7 units of red cells during the previous 9 days. Weak anti-Jk^a was identified in the post-transfusion sample (stronger one week later) in addition to the anti-E already identified. The patient was Jk(a+) pre transplant, but the donor was Jk(a-), confirming that the antibody was of donor origin. The DAT was negative pre transfusion but became positive, suggesting an acute HTR to the current red cell unit, but involving destruction of the previously transfused cells in addition. The patient's renal function had started to deteriorate the day before the current transfusion, and this was thought to be related to ongoing haemolysis of previously transfused Jk(a+) red cells.

Clinical and laboratory signs and symptoms

Acute haemolytic transfusion reactions n=18

There appears to be no typical set of clinical symptoms associated with acute haemolytic reactions, although the most commonly reported signs were fever (n=8), rigors (n=7), dark urine (n=7) and back pain (n=6), in different combinations. Other less commonly reported signs were hypotension (n=2), nausea/vomiting (n=2), and one each of hypertension, dyspnoea, flushing and jaundice.

Seven patients had clinical signs of a reaction during the transfusion, which was subsequently stopped, and the unit returned to the laboratory. One of these had fever and rigors, but showed no clinical or laboratory signs of haemolysis. It is not clear whether the anti-Wr^a subsequently identified was the cause of the reaction, or whether this was coincidental, although the implicated donation was confirmed to be Wr(a+) and retrospectively incompatible.

Two patients with red cell antibodies received emergency O D-negative red cells, and another, crossmatch compatible red cells before testing was complete. None showed any signs of a clinical reaction, but two did show laboratory signs of mild haemolysis. In the third case, treatment was withdrawn, and no further laboratory tests were undertaken, so a haemolytic transfusion reaction could not be confirmed.

The remaining 8 patients showed clinical signs of a transfusion reaction within 24 hours of completion of the transfusion.

Blood samples were taken for investigation in all cases, and urine samples collected from patients who had passed dark urine.

Delayed haemolytic transfusion reactions n=28

In 14/28 cases (50%) there were no obvious clinical symptoms associated with the DHTR, which was diagnosed by laboratory signs of haemolysis.

Of the remaining 14 patients, the most common clinical features reported were dark urine and/or jaundice, in 12/14 cases (85.7%). Fever, back pain, chest pain and dyspnoea were also reported clinical features in a minority of patients.

Haemolysis was confirmed in the majority of cases, 25/28 (89.3%), by a fall in Hb or lack of expected Hb increment. In 2 cases a transient rise in bilirubin (with or without a raised LDH) was the only indication of a mild haemolytic reaction. The final case involved high dose IVIg, given to a group A patient, which may or may not have caused a haemolytic reaction, described below.

Case 3: High dose IVIg potentially causes an HTR

A patient with chronic myeloid leukaemia (CML), blood loss and sepsis required urgent transfusion. 5/6 units were incompatible and emergency O D-negative red cells were issued. The DAT was positive, and anti-A reacting only with A_1 cells was identified in the plasma and eluted from the patient's red cells. A batch of IVIg given 4 days earlier, was identified as the source and in-house testing revealed a titre of 256 against A_1 cells in IgG cards. The patient had a raised bilirubin and did not appear to show an increment in Hb, but was septic with multiple problems including ascites and blood loss. It was felt by the reporter that the anti-A from the IVIg may have contributed to the patient's worsening clinical condition.

Learning point

- Passive anti-A from high dose intravenous immunoglobulin (IVIg) is not an uncommon cause of an incompatible crossmatch in non group O patients, although it rarely causes a severe haemolytic reaction. Group O red cell transfusions should be considered until anti-A is no longer detectable as should a different batch of IVIg, where the patient suffers a haemolytic episode (Padmore 2012)

Haemoglobinuria was reported in five patients who were noted to have passed dark urine, and 13 had a raised LDH. A DAT was undertaken as part of the DHTR investigation in all cases. It was negative in 4 cases, and positive in the remaining 24, with 13 demonstrating IgG coating only, one C3d coating only, 8 both, and two not stated.

Serological findings

Acute n=18

There were four cases this year where an antibody to a low frequency antigen was likely to have caused the reaction: three anti-Wr^a and one unspecified. All were confirmed to be retrospectively incompatible with the implicated donation. In one case there was no evidence of haemolysis, and only mild haemolysis in the others.

Learning point

- Haemolytic transfusion reactions due to antibodies directed against low frequency antigens are a small but acceptable risk of omitting the indirect antiglobulin test (IAT) crossmatch. 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

Emergency O D-negative red cells were transfused in 2 urgent cases, where the patient was retrospectively found to have a red cell antibody, incompatible with the transfused units (one each of anti-e and anti-Fy^a).

There were 6 cases where each patient had an alloantibody identified post transfusion, which had not been detected pre transfusion: anti-Jk^a (Case 2), anti-f (detectable pre transfusion using a different analyser in Case 8), anti-E (clearly identifiable by enzyme and by IAT with a different panel of red cells in Case 4), anti-M (detected one week later in a sickle cell patient), anti-C^w, and enzyme-only anti-C.

In the remaining six cases, no red cell alloantibodies were detected. Four clear haemolytic episodes were likely due to autohaemolysis exacerbated by the transfusion. This included the patient who died (Case 1, described earlier). There was no explanation for the other 2 cases, but there was significant haemolysis in both patients, with one reported to have had similar episodes with subsequent transfusions.

Learning point

- 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)

Case 4: Weak anti-E not identified prior to urgent transfusion due to a reagent failure and no enzyme panel

A patient was admitted with an upper gastrointestinal (GI) bleed and Hb 59g/L. Six units of red cells were requested as an emergency. The patient was O D-positive with a positive antibody screen and 2/6 units were incompatible by IAT. The antibody identification (ID) panel was negative as was the DAT. The 4 compatible units were transfused under concessionary release. Meanwhile, a sample was sent to the Blood Service red cell reference laboratory, where anti-E was identified clearly by enzyme and with the R_2R_2 cell (cDE/cDE) by IAT. Two of the transfused units were confirmed to be E+. Antibody identification was repeated with a new panel of cells, and a positive reaction was found by IAT with the R_2R_2 cell. The reagent failure was reported to the manufacturer. The next day, the bilirubin was slightly raised, from 6 to 31micromol/L and the LDH had increased from 285 to 400U/L. Bloods taken 12 days later showed that the Hb had remained stable, the LDH was 800U/L, the DAT was positive and anti-E was detected more strongly, but an eluate was not tested. The laboratory is considering the introduction of an enzyme panel.

Learning point

- Many antibodies reactions are enhanced by using enzyme techniques, and the British Committee for Standards in Haematology (BCSH) guidelines recommend that a panel of enzyme treated cells is available (BCSH Milkins et al. 2013)

Delayed n=28

No alloantibodies were detected in 5 patients with sickle cell disease (further details are given later).

Kidd antibodies were the most commonly implicated in the remaining reactions, being identified in 13/23 (56.5%) of cases, 8 where it was the sole specificity. Rh antibodies were the second most commonly identified, in 11 cases (47.8%), followed by Duffy and MNS (5 cases each). Kell antibodies were only implicated in 3 cases. Further details can be found in a table on the SHOT website, www.shotuk.org under SHOT Annual Reports and Summaries.

The following 2 cases demonstrate the need for transfusion laboratories to consider that weak or unexpected reactions in the antibody screen or crossmatch may be due to developing antibodies from an earlier transfusion, and that the patient may already be undergoing a haemolytic transfusion reaction.

Case 5: Weak antibody missed pre transfusion

A patient with AML (transfused 5 days previously) had a positive antibody screen by Capture and a positive DAT, but the identification panel using manual techniques was inconclusive. The patient received a routine transfusion with crossmatch-compatible red cells, while a sample was referred to the Blood Service reference laboratory where anti-E was identified by BioRad IAT and anti-c by enzyme only. No eluate was undertaken on this sample as it was thought by the reference laboratory to be a pre-transfusion sample. The next day, the patient had a slight rise in bilirubin and the Hb dropped from 97g/L immediately post transfusion to 90g/L. A further sample was referred to the reference laboratory 2-3 weeks later, which showed anti-c now detectable by IAT, but the eluate was negative. The anti-c+E were presumably developing following the earlier transfusion, and it is not clear whether the mild HTR was due to the earlier or later of the 2 transfusions.

Case 6: Weak anti-Jk^a might have been detected in an eluate pre transfusion

A patient with acute blood loss and Hb 75g/L had a positive antibody screen; anti-C plus an enzyme non-specific antibody were identified, and one of four C-negative units crossmatched was incompatible by IAT. The patient had also been transfused 3 weeks earlier, when non-specific reactions by IAT and enzyme panagglutinins had been noted. The patient was transfused with two units of C-negative, K-negative red cells, compatible by IAT. Meanwhile a sample was sent to the Blood Service reference laboratory for investigation of a suspected antibody to a low frequency antigen. The reference laboratory identified anti-Jk^a in addition to the anti-C and enzyme panagglutinins. The anti-Jk^a was only reacting with some but not all Jk(a+b-) cells in the plasma by IAT but was clearly identifiable in an eluate made from the patient's red cells, as was the anti-C. The DAT was positive, and both antibodies were presumably developing in response to the transfusion 3 weeks earlier. It is not clear whether either of the two recently transfused units were Jk(a+), but when the Hb was next measured 5 days later, there had been no increment. The patient may have been having a delayed transfusion reaction to the earlier transfusion and a more acute reaction to the recent transfusion.

Learning point

- Weak or unexpected positive reactions, in a recently transfused patient, should be investigated by more sensitive techniques, such as enzyme or enzyme indirect antiglobulin test (IAT) before further transfusion, if the clinical situation allows. An eluate should also be tested, since any IgG antibody on the transfused red cells, may be reactive more strongly, or in some cases, only in the eluate

Haemolytic reactions in patients with sickle cell disease

HTRs were reported in 11 patients with sickle cell disease, 2 acute and 9 delayed.

One acute reaction occurred in a patient who had known alloantibodies and warm autoantibodies; no further alloantibodies were detected post transfusion and this is likely to be a case of exacerbation of autoimmune haemolysis. The other acute reaction was unusual in that the bilirubin was raised, the Hb did not increment, and the DAT became positive post transfusion, but no antibodies were detectable in the plasma or eluate until one week later, when anti-M was identified.

The newly appointed hyperhaemolysis review panel confirmed four cases of hyperhaemolysis with the clinicians using the 'post-transfusion hyperhaemolysis referral and follow-up form', and these cases were subsequently reported to SHOT in the usual way. The reaction was first reported between 6 and 8 days post transfusion, and in each case the Hb continued to fall to several g/L below pre-transfusion levels. No alloantibodies were detected in 3 of these cases. The 4th case is more complicated as the patient was transfused 4 units of red cells on holiday in a different country 7 days before presenting at hospital in the UK, with severe anaemia (38g/L), pain, fever and nausea. Following further transfusion, the Hb fell to 26g/L and she was treated with IVIg and methylprednisolone, and was moved to the high dependency unit (HDU). Anti-S+Jk^{b} were present on admission, and anti-Fy^{a}, anti-M plus a pan-reactive autoantibody were identified post transfusion. The low Hb and a low reticulocyte count, confirmed this as hyperhaemolysis.

Another patient showed a similar pattern of results to the first 3 cases, with a Hb lower than the pre-transfusion level, and no alloantibodies; this case was not referred to the review panel at the time of the reaction, and insufficient details are available to confirm whether or not this is a further case of hyperhaemolysis.

Three patients with sickle cell disease suffered minor morbidity as the result of classic delayed HTRs due to red cell alloantibodies (anti-E (Case 7), anti-S, and multiple specificities).

The final patient is more difficult to classify. She had a haemolytic episode 14 days post transfusion, with fever and back pain, red plasma, dark urine, a raised bilirubin and Hb 10g/L lower than immediately post transfusion, but although the DAT was positive, no alloantibodies were detected in the plasma or eluate.

Case 7: Incorrect historic phenotype leads to DHTR due to anti-E

A patient with sickle cell disease was exchange transfused with R_2R_2 (cDE/cDE) red cells based on an incorrect historical phenotype undertaken in 1984. 18 days later, the patient had back pain, rigors and dark urine, the bilirubin was raised and the Hb was 40g/L lower than it had been post exchange; the DAT was positive and anti-E was identified in the plasma, although the eluate was negative. The patient had been suffering from several recent sickle cell crises, but did appear to be suffering from a DHTR as well. The laboratory has subsequently changed its policy to undertake a second Rh phenotype where there has been no recent transfusion activity.

Eluates

An eluate was tested in 21/28 cases of DHTR, and revealed a specific antibody in 13/21. The eluate was negative in 6 cases, had non-specific reactions in one case and no result was stated in another. Anti-E was identified in the eluate in one case where the DAT was negative. An eluate was not tested in 7 cases, 3 were cases of hyperhaemolysis where no alloantibody was present and the DAT was negative. The other 4 all had alloantibodies identified and a positive DAT. Two of these were referred to Blood Service reference laboratories - in one of these, an eluate had been undertaken recently revealing panreactive antibodies, so it was not considered helpful to repeat the test, as any alloantibodies would be masked by autoantibody; in the second of these, the reference laboratory should have prepared an eluate, but overlooked the test. The other 2 cases without testing of an eluate were not referred to a reference laboratory.

Timing of reaction

Delayed

The delayed reactions were detected between 2 and 40 days post transfusion with a median of 7 days. However, there were three further cases where the time period was unclear as the patients had received several transfusions over a number of days. Details are available on the SHOT website, www.shotuk.org under SHOT Annual Reports and Summaries.

Role of serological techniques

In 2 cases the reporter noted that the IAT method failed to detect the implicated antibodies.

Case 8: Weak antibody detected retrospectively on different analyser

A patient was transfused following a negative antibody screen on the Immucor Echo analyser, and subsequent electronic issue. She developed fever, hypertension and back pain after the first unit, triggering repeat serological testing. Post-transfusion investigation revealed anti-f in the pre-transfusion sample using the Immucor Galileo analyser and also by manual DiaMed technique, but not on the Echo. The conclusion, following investigation by the manufacturer, was that this antibody was at the threshold for detection and the analyser was working as expected.

Case 9: Weak antibody reacts differently by different technologies

A patient had a positive antibody screen using the Immucor Neo analyser, but gave non-specific results in the panel. Units were crossmatched and found compatible by DiaMed. Two days post transfusion, the patient had chest pain and dyspnoea, a raised bilirubin and a positive DAT, anti-Jk^a was identified. The hospital is moving towards crossmatching by the Immucor Neo.

Learning points

- Different indirect antiglobulin test (IAT) technologies have different sensitivities and it is unlikely that any single technology will be the best at detecting all weak antibodies
- Kidd antibodies are often difficult to detect and it is worth considering testing a serum sample and/or using an enzyme antiglobulin test where the antibody screen is weakly positive but no specific alloantibody can be identified

References

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

Padmore RF. (2012) **Haemolysis upon intravenous immunoglobulin transfusion** (review article). Transfus Apher Sci 46, 93-96

Petz LD, Garratty G (2004) **Blood Transfusion in AIHAs**. In Immune Haemolytic Anaemias, 2nd edition, 375-400, Churchill Livingstone, New York.

Young P, Uzieblo A, et al. (2004) **Autoantibody formation after alloimmunisation: are blood transfusion a risk factor for autoimmune haemolytic anaemia?** Transfusion 44(1), 67-72

Alloimmunisation (Allo) n=151

16

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.

This is an optional reporting category; however we are actively seeking reports of alloimmunisation to anti-D, whether or not the patient has deliberately or inadvertently received D-positive red cell components, or where the cause is unclear.

Key SHOT messages

- Wherever possible, D-negative patients who require chronic transfusion support should receive D-negative red cell components (BCSH Milkins et al. 2013). However, this may not always be possible where human leucocyte antigen (HLA)-matched platelets are required. Females of childbearing potential should receive prophylactic anti-D immunoglobulin (Ig) in these circumstances (BCSH Qureshi et al. 2014)
- Apparent anti-C+D in pregnancy should be confirmed by a reference laboratory, as in a proportion of individuals the specificity will actually be anti-C+G, in which case routine anti-D Ig prophylaxis will be required (BCSH Gooch et al. 2006)

Number of cases

There are 151 cases, including 6 transferred from haemolytic transfusion reactions (HTR), and 3 from other categories. This is a third more reports than last year (n=114 in 2013), and probably just represents an increase in reporting awareness.

Age of patients

Patients ranged from 14 to 96 years, with a median of 70 years.

Specificity of new antibodies identified post transfusion

Table 16.1 shows these by frequency of identification, rather than by blood group system, and the top three are the same as last year. It is notable that the profile of the antibodies identified differs from those responsible for delayed haemolytic transfusion reactions (DHTR) 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 greater 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' (BCSH 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.

Table 16.1: Specificity of new antibodies

Specificity	Number of cases
E	27
K	19
Mixture including Rh (one anti-C+G)	18
c (+/- E)	18
Jk^a	14
Fy^a	12
D or D+C or D+C+E	6
Jk^b	5
Lu^a	5
Other mixture	4
C^w	4
M	4
S	3
C	2
Kp^a	2
One each of Fy^b, e, G, Ch1, Le^a, s, Wr^a, weak non-specific	1 of each (8 cases)
Total	**151**

Development of anti-D n=6

Three elderly female patients developed anti-D following transfusion of D-positive red cells (2 cases) or platelets (one case).

A patient with weak D type 2 (confirmed by genotyping) received D-positive red cells and platelets. Three years later, anti-D was identified plus a weak anti-C detectable by enzyme technique only. The direct antiglobulin test (DAT) was positive and anti-D was eluted from the red cells, confirming this as auto anti-D.

A D-negative male patient, who already had anti-Fy^a, developed anti-D following transfusion with D-positive, HLA-matched platelets.

A D-negative elderly female patient with acute myeloid leukaemia (AML) was transfused with D-positive red cells at hospital X, and anti-D was detected 3 weeks later at hospital Y where she was due to receive a haemopoietic stem cell transplant.

Learning points

- D-negative patients who are likely to require long term transfusion support should receive D-negative red cell components
- Patients who are already alloimmunised are more likely to make further alloantibodies, and where possible D-negative patients should receive D-negative red cell components. However, HLA-matching may take precedence over D matching

Anti-G (or anti-C+G)

There were two reports of anti-G this year.

- One D-negative patient with anti-Fy^a received many units of D-negative red cells and platelets. Four weeks later a second antibody was detected that was eventually confirmed as anti-G by the red cell reference laboratory. One of the platelet donors was subsequently confirmed as r'r (Cde/cde)

- A second D-negative patient was given 500IU of prophylactic anti-D Ig and transfused with D-negative red cells, post delivery, 2 years ago. At a subsequent booking in 2014, the patient apparently had anti-C+D. On investigation, the antibody was identified as anti-C+G and one of the D-negative red cells transfused 2 years earlier was confirmed to be r'r (Cde/cde). The pregnancy is being managed in line with British Committee for Standards in Haematology (BCSH) guidelines (BCSH Qureshi et al. 2014) and the patient will receive routine antenatal anti-D Ig prophylaxis (RAADP) and post-delivery anti-D Ig

Interval between the transfusion and detection of new antibodies

The time intervals reported ranged from 2 days to weeks, months or even years.

References

BCSH Gooch A, Parker J et al. (2006) **Guideline for blood grouping and antibody testing in pregnancy**. http://www.bcshguidelines.com/documents/antibody_testing_pregnancy_bcsh_07062006.pdf

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

BCSH Qureshi H, Massey E et al. (2014) **Guideline for the use of anti-D immunoglobin for the prevention of haemolytic disease of the fetus and newborn**. Transfus Med 24(1), 8-20

17 Transfusion-Transmitted Infection (TTI) n=1 event, 2 recipients

Authors: Claire Reynolds and Su Brailsford

Definition of a TTI:

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.

Summary

United Kingdom (UK) Blood Service investigations in 2014 have confirmed that there were:

- No proven bacterial transfusion-transmissions reported in 2014
- Two near miss bacterial incidents
- One transfusion-transmitted hepatitis E virus (HEV) incident following a transfusion in 2014 affecting 2 recipients

The risk of bacterial transmission is not completely abolished by bacterial screening of platelets. Therefore the UK Blood Services and hospitals are reminded that visual inspection of packs before issue and use is a crucial safety step in minimising potential bacterial transfusion transmissions. The Blood Service should be informed immediately of significant adverse reactions including those suspected of being the result of bacterial contamination of a component.

The risk of a screened component transmitting hepatitis B virus (HBV), hepatitis C virus (HCV) or human immunodeficiency virus (HIV) in the UK is very low. Nevertheless, to maintain haemovigilance, investigations are performed if a recipient is suspected to have been infected via transfusion.

Blood donations in the UK are not currently screened for HEV. The Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) has set up a working group to consider the risk of hepatitis E transmission via blood and what action, if any, should be taken.

Table 17.2 shows the 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 2014 (Scotland included from October 1998).

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 2014.

Summary of reports made to the NHSBT/PHE Epidemiology Unit in 2014

During 2014, the UK Blood Services were asked to investigate 117 suspected TTI incidents, a similar number to recent years, consisting of 93 possible bacterial cases and 24 suspected viral incidents (Figure 17.1).

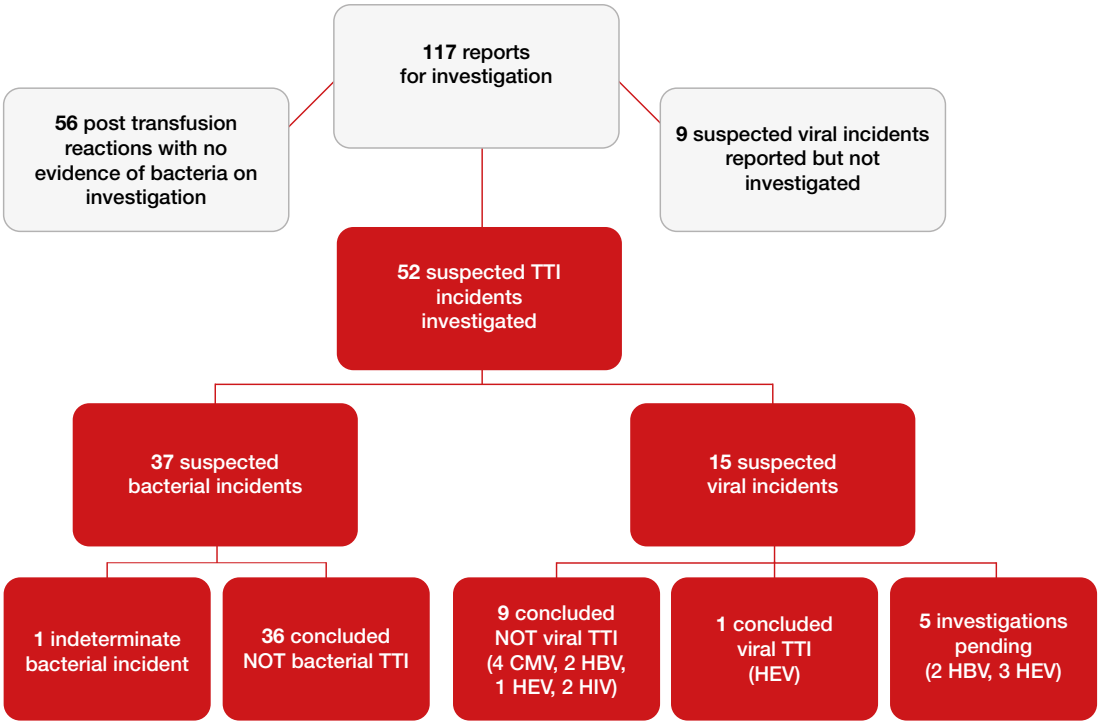


Figure 17.1: Outcome of reports of suspected TTIs made to the NHSBT/PHE Epidemiology Unit in 2014*

**HCV investigations where the transfusion was prior to screening are not included in above figure*

CMV=cytomegalovirus

Bacterial reports 2014

A total of 56/93 packs returned to the Blood Service with a request for bacterial culture following a patient reaction had no bacteria detected in the pack, and no positive patient blood culture reported by the hospital. These possible transfusion reactions may have been reported to SHOT as ATRs if moderate to severe reaction occurred. In 36 possible bacterial cases, the recipient's transfusion reaction was probably not caused by bacteria from a transfusion of a blood component from the UK Blood Services. One case remained indeterminate as packs were not available for culture but the patient was known to have underlying septicaemia prior to transfusion.

Bacterial TTIs 2014

There were no proven bacterial incidents in 2014 but two near miss incidents are described below.

Bacterial contamination of platelets not identified by screening

Two similar near miss incidents (reported May and December 2014) were investigated by the UK Blood Services. There were no obvious errors in sampling or screening processes in either case although culture bottles were not available for inspection.

- Two units of apheresis platelets were issued from one donation. On day four, the hospital reported a clump in the index pack, resulting in the recall of the associated pack. Although *Staphylococcus aureus* was isolated from the index pack, pack two looked normal and on culture there was no evidence of bacterial contamination. Bacterial screening was negative for both packs at day seven. The donor had given three previous donations. *S. aureus* was cultured from swabs taken from the donor. All isolates were indistinguishable from the strain isolated from the pack. The donor has since been permanently withdrawn
- In the second case three apheresis units were manufactured from one donation. The hospital observed clumps in the index unit on day five, at which point the unit was returned and the two other associated packs recalled. Bacterial screening was negative at day seven for all three packs. On return of the index pack *S. aureus* was isolated from the index pack. The two associated packs had already been transfused at the time of recall but no adverse reaction was reported in either case. At the time of writing bacterial typing is ongoing

Bacterial TTIs 1996-2014

The last documented confirmed bacterial TTI was in 2009, but this predated universal bacterial screening of platelets throughout the UK Blood Services and the lack of cases may not, therefore, be totally explained by the introduction of screening. Conversely 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.

Overall, a total of 36/43 bacterial transfusion-transmissions to individual recipients (33 incidents) have been caused by the transfusion of platelets, and 7/43 by red cells (Table 17.2) since reporting began.

Viral TTI reports 2014

In 2014 nine suspected viral incidents reported to the Blood Service were not investigated for the following reasons: positive HBV antibody results were due to passive antibody transfer during intravenous immunoglobulin therapy (2); HCV infection was not confirmed; infection was not proven to be absent prior to transfusion.

Viral investigations 2014

Fifteen reports of suspected viral TTIs made in 2014 were investigated. One suspected HEV incident was confirmed as a TTI according to the above definition, Case 1.

Case 1: Report of HEV transmission

A male recipient in his 70s with multiple chronic medical problems, known alcoholic liver disease and lower gastrointestinal bleeding secondary to diverticulitis received red cells, platelets and fresh frozen plasma (FFP) in September 2014 totalling 17 donor exposures. He was discharged from hospital but subsequently readmitted with hepatic encephalopathy. Investigation included testing for viral hepatitis markers, with results consistent with acute hepatitis E infection.

HEV is most commonly transmitted through food but can be transmitted through blood components if a donor donates during the viraemic phase of infection. The local Health Protection Team reported the case to the Blood Service for investigation. Testing of the 17 donation archive samples identified two with HEV markers: one indicative of previous exposure while one, from which the FFP had been transfused to the recipient, was HEV ribonucleic acid (RNA) positive without detectable antibodies. The viraemic

donor, who had been completely asymptomatic, provided a further blood sample to confirm clearance of the virus and seroconversion. The associated red cells from the viraemic donor were transfused in October 2014 and the recipient had shown no symptoms of HEV infection. A blood sample in February 2015 had test results consistent with a resolving HEV infection: anti-HEV IgM and IgG positive, and HEV RNA low level positive. The recipient had received chemotherapy and radiotherapy one year previously, no doubt accounting for the delayed clearance of the HEV infection, which was nevertheless expected to resolve over the following months.

Viral TTIs 1996-2014

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, 26 confirmed incidents of transfusion-transmitted viral infections have been documented, involving a total of 32 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 risks of a component potentially infectious for HBV, HCV or HIV being released for use in the UK are very low (Table 17.1) (PHE 2014).

	HBV	HCV	HIV
Number per million donations	0.46	0.026	0.17
95% confidence interval	0.14-0.87	0.01-0.07	0.10-0.82
At 2.3 million donations per year testing will not identify a potentially infectious window period donation every:	year	16-17 years	2-3 years

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

Table 17.1: The estimated risk of a potentially infectious HBV, HCV or HIV window period* donation entering the UK blood supply: 2011-2013

Far fewer TTIs are observed in practice than estimated in Table 17.1, 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 underascertainment/underreporting, 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 commentary

The UK Blood Services' Standing Advisory Committee on Transfusion Transmitted Infection (SACTTI) is alerted to any new infectious threats to the UK blood supply through a wide range of reporting mechanisms, and will commission risk assessments where necessary to inform decisions on whether action should be taken to protect the safety of the blood supply (JPAC 2013). There has been a recent increase in the number of cases of HEV reported to the UK Blood Services for investigation as suspected TTI incidents, probably due to increased awareness (Beale et al. 2011). An HEV study conducted jointly by NHSBT and PHE to address the growing concern about HEV and blood safety identified 18 transmissions from 79 HEV viraemic donors with no major consequences for the recipients observed to date; only one recipient developed apparent but clinically mild post-transfusion hepatitis (Hewitt et al. 2014). The Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) has set up an HEV working group due to report in 2015 to consider the risk of hepatitis E transmission via blood and what action, if any, should be taken.

CMV commentary

Four investigations for CMV infection, three in premature babies and one in an elderly recipient, were carried out in 2014. This was a higher number than usual, possibly due to increased awareness and/or tendency to report cases since the changes in recommendations for the use of CMV-screened blood components. There has been no reported proven CMV TTI in the UK and one indeterminate case out of a

total of 10 investigations for suspected CMV TTI since surveillance began in 1996 up to December 2014. CMV is a herpes virus that gives rise to a life-long infection which is mostly asymptomatic. Significant disease may occur in certain groups, such as fetuses, neonates and immunocompromised individuals. In the UK up to 50-60% of adults are CMV seropositive, with an estimated seroconversion rate of 1% per annum. A CMV seropositive individual can have asymptomatic or symptomatic reactivation of latent virus throughout life, with opportunities for transmission. This is a cell-associated virus and it is normally found in lymphocytes, but during periods of high virus replication, excess virus can be readily detectable in plasma. A proportion of donations are screened by the UK Blood Services for CMV antibody to provide a 'CMV ***sero***negative' inventory of cellular components, which are provided to hospitals on request.

SaBTO has recommended that CMV seronegative red cell and platelet components should be provided for intrauterine transfusions, neonates and pregnant women while leucodepletion was considered adequate risk reduction for all other patients requiring transfusion, including other groups of immunocompromised patients (SABTO 2012).

Parasitic TTIs

There were no reported parasitic infections for investigation in 2014. There have been two proven malaria TTIs reported to SHOT, the last in 2003 (Table 17.2). 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) 2014

There were no vCJD investigations in 2014.

vCJD 1996-2014

Three vCJD incidents (Table 17.2) 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 (SABTOa 2013).

vCJD control measures

Risk assessment and research into vCJD continues. New data suggest 1 in 2000 people in the UK may be carriers of vCJD (Gill et al. 2013). Despite international research efforts there is currently no suitable blood test available for screening blood donations for vCJD. SaBTO is continuing to review the measures in place to prevent transmission through blood transfusion (SABTOb 2013, DH 2013). This includes considering the best uses of donations from people in the UK believed to be at lower risk of vCJD i.e. those born since January 1996 and not thought to be exposed via the food chain. These young adults became old enough to donate in the UK from January 2013. A House of Commons Select Committee inquiry to determine if the control measures in place are sufficient to minimise transfusion-transmitted infection in light of the potential for large numbers of carriers published its report in July 2014 (Science and Technology Committee 2014). This is available on the parliament website together with the government response.

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
Pre 1996	0	0	1 (1)	0	0	0	2 (2)	0	0	0	**3 (3)**	3	0	0	0
1996	0	1(1)	1 (1)	1 (1)	0	1 (3)	0	0	0	1 (1)	**5 (7)**	5	1	0	1
1997	3 (3)	0	1 (1)	1 (1)	0	0	0	0	1 (1)	2 (2)	**8 (8)**	6	1	1	0
1998	4 (4)	0	1 (1)	0	0	0	0	0	0	0	**5 (5)**	2	1	2	0
1999	4 (4)	0	2 (3)	0	0	0	0	0	0	‡ (1)	**6 (8)**	5	3	0	0
2000	7 (7)	1 (1)	1 (1)	0	0	0	0	0	0	0	**9 (9)**	1	5	3	0
2001	5 (5)	0	0	0	0	0	0	0	0	0	**5 (5)**	0	4	1	0
2002	1 (1)	0	1 (1)	0	0	1 (1)†	0	0	0	0	**3 (3)**	2	1	0	0
2003	3 (3)	0	1 (1)	0	0	0	0	0	1 (1)	0	**5 (5)**	1	1	3	0
2004	††	0	0	0	1 (1)	0	0	0	0	0	**1 (1)**	1	0	0	0
2005	2 (2)	1 (1)	1 (1)	0	0	0	0	0	0	0	**4 (4)**	1	3	0	0
2006	2 (2)	0	0	0	0	0	0	0	0	0	**2 (2)**	0	1	1	0
2007	3 (3)	0	0	0	0	0	0	0	0	0	**3 (3)**	2	1	0	0
2008	4 (6)	0	0	0	0	0	0	0	0	0	**4 (6)**	0	2	4	0
2009	2 (3)	0	0	0	0	0	0	0	0	0	**2 (3)**	1	0	2	0
2010	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0
2011	0	0	1 (2)	0	1 (2)	0	0	0	0	0	**2 (4)**	2	0	0	2
2012	0	0	1 (1)	0	1 (1)	0	0	1(1)	0	0	**3 (3)**	2	0	0	1
2013	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0
2014	0	0	0	0	1 (2)	0	0	0	0	0	**1 (2)**	1	0	0	1
Number of incidents	**40**	**3**	**12**	**2**	**4**	**2**	**2**	**1**	**2**	**3**	**71**				
Number of infected recipients	43	3	14	2	6	4	2	1	2	4	**81**	**35**	**24**	**17**	**5**
Death due to, or contributed to, by TTI	11	0	0	0	0	0	0	0	1	3	**15**				
Major morbidity	28	2	14	2	3	4	2	1	1	1§	**58**				
Minor morbidity	4	1	0	0	3	0	0	0	0	0	**8**				
Implicated component															
RBC	7	1	11	2	3	2	2	1	2	4	**35**				
Pooled platelet	20	2	1	0	0	1	0	0	0	0	**24**				
Apheresis platelet	16	0	1	0	0	0	0	0	0	0	**17**				
FFP	0	0	1	0	3	1	0	0	0	0	**5**				

Table 17.2: 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 2014 (Scotland included from October 1998)**

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 have been combined into the advice below:

A recipient has had a reaction during a transfusion – could it be due to bacteria in the pack?

Yes bacterial contamination is a factor to be considered, although no bacterial TTIs have been reported since 2009.

- Screening of platelets will not prevent units with bacteria present entering the supply. Platelets are released as negative-to-date. Bacterial transmissions may occur via red cells, which are not screened for bacteria

Before transfusion: be vigilant. Clumps in the (platelet) pack? Send it back!

- Visual inspection of packs before issue and use remains a crucial safety step in minimising risk of bacterial transfusion transmitted infection
- Visual inspection of packs can alert staff to signs of bacterial growth (Figure 17.2). Two near miss incidents involving *S. aureus* in platelet packs were reported in 2014
- Swift reporting of a suspected contaminated pack allows recall to occur before any associated* packs are used

Figure 17.2: Example of a platelet pack contaminated with Staphylococcus aureus

**Note: There may be associated packs produced from the same donation which have been issued perhaps to different hospitals who will be unaware of the potential problem. Clumps may not appear in the associated pack. Both apheresis and pooled platelets may have associated packs. An apheresis donation is made by a single donor and may be split into several platelet packs. A pooled platelet pack is currently made from the whole blood donations from four donors whose donations are also used to make red cell packs*

After transfusion: report promptly to Blood Service, retain and return pack

- Report a suspected bacterial transfusion transmitted infection (TTI) promptly to the Blood Service to allow recall of any associated packs for testing
- Retain suspected bacterially contaminated packs, even if near empty, for return to the Blood Service as the residue can be washed out and cultured
- If you are sampling packs locally for bacterial testing, use ports rather than breaching the pack to minimise environmental contamination of the pack

Advice on clinical management and investigation of serious adverse reactions can be obtained from the hospital consultant responsible for blood transfusion and the British Committee for Standards in Haematology (BCSH) guideline on investigation and management of acute transfusion reactions (BCSH Tinegate et al. 2012).

A recipient of a blood transfusion(s) has been found to have a viral infection – could it be the blood?

Yes, although very rare and other sources should be explored

- The risk of transfusion-transmitted HBV, HCV or HIV is very low in the 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. HEV is commonly transmitted by food for example. Investigation includes checking records and

testing samples taken prior to the implicated transfusion(s) to check that the recipient was not infected prior to transfusion

A transfusion investigation will not commence until the infection status of the recipient has been clarified

- Investigation of possible HCV transmission in individuals who are HCV polymerase chain reaction (PCR) negative, HCV antibody reactive, will not commence unless HCV antibody reactivity has been confirmed using two different assays, because of the possibility of non-specific antibody reactivity. If not locally available, the Blood Service can perform the required testing
- Cytomegalovirus (CMV) seroconversion should be demonstrated by testing samples from before and after transfusion in parallel by the same laboratory
- Immunoglobulin therapy can lead to passive transfer of antibodies which may be confused with infection (Parker et al. 2014). Careful review of the markers and timing can rule out infection before a report is made to the UK Blood Services
- The local microbiologist/virologist should be consulted for advice.

Archive samples kept by hospitals and the Blood Service help verify infection status, timing and source

- Hospitals and Blood Services investigating a possible viral TTI are reminded of the importance of locating any archived recipient samples (transfusion-related or not) for testing. It is important that laboratories facilitate access to those samples (with due consent of appropriate parties including the patient)
- The large number of donors to investigate in some cases, and the retrospective nature of some investigations, emphasises the importance of UK Blood Services maintaining an easily accessible system for archive samples

How do I report a suspected TTI for investigation by the Blood Service?

- Guidance on reporting an incident, and the required supporting information, for suspected transfusion transmitted infections (TTIs) for hospitals served by NHSBT can be found on the Requests for Investigation of Adverse Events & Reactions page at: http://hospital.blood.co.uk/diagnostic-services/reporting-adverse-events/
- For other UK Blood Services please contact the local Blood Centre

Do I need to report potential TTIs to MHRA and SHOT?

Yes, report as soon as practical to both systems and remember to update the outcome

- Clinical staff requesting an investigation into a possible transfusion-transmitted infection (TTI) by the UK Blood Services are reminded to report as soon as practical to Serious Adverse Blood Reactions and Events (SABRE) and SHOT
- Reporters should update their report once the outcome of the UK Blood Services investigation is known
- Even if bacterial TTI is excluded in a case of transfusion reaction, the case should still be reported to SHOT and the MHRA as an ATR if necessary
- Cases of suspected transmission of infection should be reported even if not currently screened for by the Blood Service

References

Beale MA, Tettmar K et al. (2011) **Is there evidence of recent hepatitis E virus infection in English and North Welsh blood donors?** Vox Sang 100, 340-342

BCSH Tinegate H, Birchall J, et al. (2012) **Guideline on the investigation and management of acute transfusion reactions**. Prepared by the BCSH Blood Transfusion Task Force. Br J Haematol 159(2),143-153

Department of Health (2013) **vCJD and transfusion of blood components: an updated risk assessment**. https://www.gov.uk/government/publications/vcjd-and-transfusion-of-blood-components-updated-risk-assessment [Accessed 23/04/2015]

Gill ON, Spencer Y, et al. (2013) **Prevalent abnormal prion protein in human appendixes after bovine spongiform encephalopathy epizootic: large scale survey**. BMJ 347,f5675

Hewitt PE, Ijaz S, et al. (2014) **Hepatitis E virus in blood components: a prevalence and transmission study in southeast England**. Lancet 384,1766-1773

JPAC (2013) **Joint UKBTS / HPA Professional Advisory Committee Position Statement on Emerging Infections**. http://www.transfusionguidelines.org.uk/document-library/position-statements [Accessed 01/04/2015]

Kitchen AD, Barbara JA, et al. (2005) **Documented cases of post-transfusion malaria occurring in England: a review in relation to current and proposed donor-selection guidelines**. Vox Sang 89,77-80

Parker S, Gil E, et al. (2014) **Case report: passive transfer of hepatitis B antibodies from intravenous immunoglobulin**. BMC Infect Dis 14,99 http://www.biomedcentral.com/content/pdf/1471-2334-14-99.pdf [Accessed 23/04/2015]

PHE (2014) **NHSBT/ PHE Epidemiology Unit: Safe Supplies: Reflecting on the population. Annual Review from the NHS Blood and Transplant/Public Health England Epidemiology Unit, 2013**. https://www.gov.uk/government/collections/bloodborne-infections-in-blood-and-tissue-donors-bibd-guidance-data-and-analysis [Accessed 23/04/2015]

SABTO (2012) **Cytomegalovirus tested blood components position statement**. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/215125/dh_133086.pdf [Accessed 23/04/2015]

SABTOa (2013) **Measures currently in place in the UK to reduce the potential risk of transmitting variant Creutzfeldt-Jakob disease via blood**. https://www.gov.uk/government/publications/current-measures-to-reduce-the-risk-of-vcjd-transmission-by-blood [Accessed 23/04/2015]

SABTOb (2013) **Advisory Committee on the Safety of Blood, Tissues and Organs Annual Report 2012 to 2013**. https://www.gov.uk/government/publications/sabto-annual-report-2012-to-2013 [Accessed 23/04/2015]

Science and Technology Committee - Second Report (2014) **After the storm? UK blood safety and the risk of variant Creutzfeldt-Jakob Disease**. http://www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/inquiries/parliament-2010/blood-tissue-and-organ-screening/ [Accessed 23/04/2015]

New or Unclassifiable Complication of Transfusion (UCT) n=5

18

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.

NB: Serious reactions in this category are **reportable to the EU** as they are 'uncategorised unintended responses'. Both paediatric cases below fit this description.

Key SHOT message

- Reporters are reminded that this category should not be used for possible allergic reactions. These should be reported as an acute transfusion reaction (ATR) and/or discussed with the SHOT staff prior to reporting

Case reports

Ten cases were originally included this year. Two of these were transferred to ATR and three were withdrawn. There were no reports of necrotising enterocolitis in neonates. Three people gave false identification which complicated their management. Details of these are included in Chapter 8 Human Factors.

The remaining reports include two children (Chapter 20 Paediatric Cases):

- A one day old female child became very unwell during transfusion, but after investigation this was concluded to be caused by the wrong route of transfusion
- A one day old male infant apnoeic and hypotensive during exchange transfusion for haemolytic disease of the newborn required admission to intensive care and ventilation

19 Pulmonary Complications

This chapter includes data for cases reported as transfusion-associated circulatory overload (TACO) and transfusion-associated dyspnoea (TAD).

It does not include cases of acute transfusion reaction in which there was a respiratory component to their reactions e.g. allergy with bronchospasm, wheeze, stridor, angioedema or anaphylaxis. These are found in Chapter 14 Acute Transfusion Reactions (ATR). The data for Transfusion-Related Acute Lung Injury (TRALI) (Chapter 27) can be found on the SHOT website, www.shotuk.org under SHOT Annual Reports and Summaries. TRALI has decreased with the move to males as the source for all fresh frozen plasma (FFP). It is less common than TACO.

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).

Transfusion-Associated Circulatory Overload (TACO) n=91

Authors: Harriet Lucero and Paula Bolton-Maggs

The current definitions of TACO are unsatisfactory. Tachycardia is a non-specific sign, and the blood pressure may decrease or increase. The International Society of Blood Transfusion (ISBT) working party on definitions is currently making a revision. The SHOT data collected in 2014 have been analysed against four different available definitions.

Key SHOT messages

- Current definitions for TACO are under revision – use of different definitions results in different numbers of cases
- TACO may occur at any age
- Cases should be reported to SHOT if there is evidence of respiratory distress that has improved with treatment for circulatory overload such as diuretics, nitrates or morphine

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

Overall 91 cases were analysed compared to 96 in 2013.

- Death was recorded for 13 patients, and in 6 of these TACO was contributory: imputability 3 (definite) in one case, imputability 2 (likely contribution) in 3 cases and imputability 1 (possibly related) in 2 cases
- Major morbidity (admission to intensive care or high dependency with ventilation) was recorded in 36 cases. Most cases occurred on the wards and were routine transfusions (Table 19.1)

Location of transfusion	
ED	2
HDU/ITU/CCU	12 (13.2%)
Theatres	3
Wards	60 (65.9%)
Day unit	6
Outpatients	4
Community hospital	2
Delivery ward	2

Emergency or routine transfusions	
Emergency or urgent	32 (35.2%)
Routine	59 (64.8%)

Table 19.1: Location and urgency of transfusion

ED=Emergency department, HDU=high dependency unit, ITU=intensive therapy unit, CCU=coronary care unit

The age range was from 1 to 98 years, median 69.5 years. The age distribution by decade is shown in Figure 19.1. It is important to note that although TACO most commonly occurs in the elderly it can occur at any age. Younger patients may be vulnerable because of associated medical conditions. It is notable that two cases occurred after transfusion at community hospitals resulting in change in practice in one. It is unfortunate that the case in which the relationship between transfusion and death was certain was transfusion of an elderly man with anaemia due to folate deficiency whose clinical history had not been fully documented and whose care was described as 'unacceptable'.

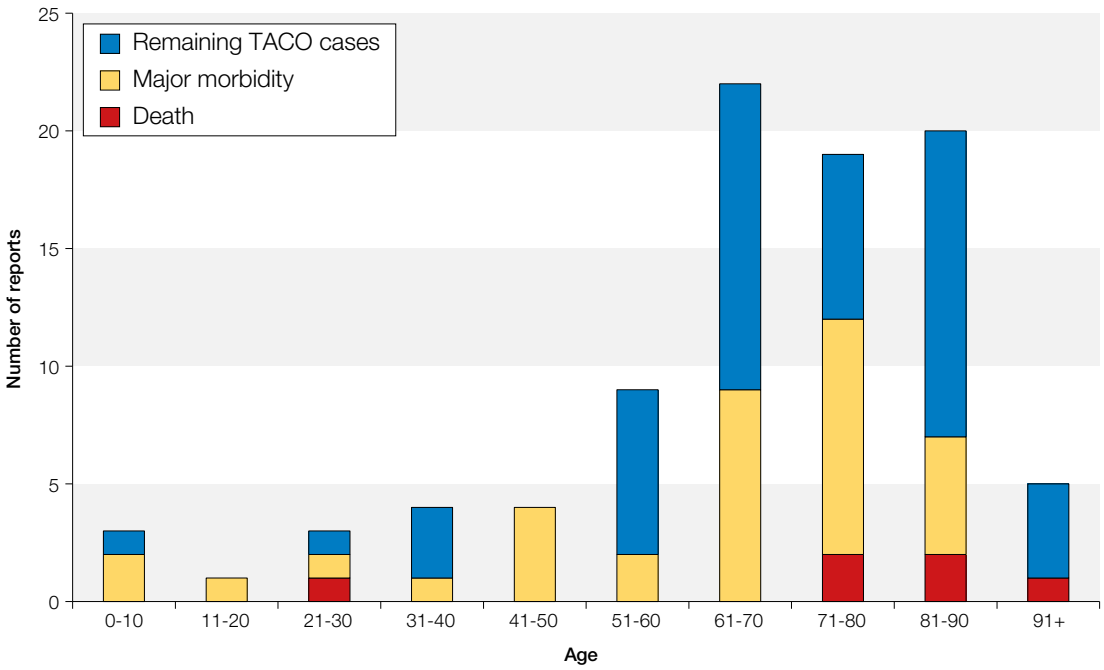
Case 1: A young person with serious comorbidity died following transfusion

A 22 year old woman with decompensated alcoholic liver disease was in intensive care, intubated and ventilated. Her coagulation tests were deranged and the decision was made to transfuse 3 units of fresh frozen plasma (FFP), 2 of cryoprecipitate and 1 unit of red cells. After the unit of red cells, which was the last component to be given, she suffered cardiac arrest, and required 10 minutes of cardiopulmonary resuscitation before return to spontaneous circulation. The chest X-ray after this event was markedly worse than before. The patient died the following day and the clinical team considered that the transfusion had contributed to her death.

Case 2: TACO follows transfusion in a community hospital

An elderly man with disseminated malignancy including pulmonary metastases was admitted to his community hospital for transfusion of 2 units of red cells. He suffered from pre-existing congestive cardiac failure and renal impairment, and was short of breath. The staff were concerned but encouraged by the oncology team at the hospital to proceed. Later the same day (between 6 and 12 hours later) the man was admitted to hospital with fluid overload, and with treatment produced a diuresis of more than 4L but later died. The transfusion was considered contributory to his death. Following review it was agreed that patients with pre-existing cardiac and other co-morbidities would not be accepted for transfusion in the community hospital.

Figure 19.1: TACO cases analysed by decade of life and outcome



Diagnosis of TACO

Cases this year were assessed for the probability of TACO against 4 different definitions. The current ISBT definition is not satisfactory for a number of reasons. Hypo or hypertension may occur; tachycardia is a very non-specific sign. TACO is probably underreported. All cases of suspected TACO should be reported even if they do not meet the current ISBT definition. All cases of dyspnoea associated with improvement following treatment of circulatory overload should be reported.

The four definitions compared are as follows:

1. Current ISBT definition

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

It has been appreciated for some time now that this definition does not capture all cases of TACO. Potential reasons for this include the probability being reduced by the reporter not providing the information such as blood pressure (BP) or heart rate. Also it is now known that TACO can occur with hypotension and cases can occur after 6 hours as demonstrated by SHOT. This was reviewed in more detail in last year's Annual SHOT Report when the' key features' definition was developed by Hannah Cohen.

2. 'Key features' definition from 2013 Annual SHOT Report (KF)

- Acute respiratory distress (in the absence of other specific causes)
- Acute or worsening pulmonary oedema
- Evidence of a positive fluid balance
- Evidence of volume intolerance

The author (Hannah Cohen) reviewed all of the information available in the reports to determine the probability of TACO. The decision was mainly based on the key features listed above but also included other information such as the patient's weight and findings on clinical examination to reach a conclusion. This demonstrated that more cases could be considered as 'highly likely' TACO in comparison to the ISBT definition, however this assessment was not based on a reproducible scoring system and therefore is not easy to replicate.

3. Draft revised ISBT definition (DRISBT) (January 2015)

Cases of TACO are characterised by acute or worsening respiratory distress within 6 hours of transfusion (some cases may occur up to 12 hours), with the following features:

Primary features

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

Features to support the diagnosis are:

- Elevated B-type natriuretic peptide (BNP) or N-terminal (NT)-pro BNP to more than 1.5 times the pre-transfusion value (if available)
- Increased mean arterial pressure or increased pulmonary wedge pressure. Typically the mean arterial pressure (MAP) is raised, often with widened pulse pressure; however hypotension may occur (in cases of acute cardiac collapse)

Confirmed cases (definite imputability - 3) should show at least two primary features or one in combination with two supportive features. Cases with only one primary feature (e.g. without chest imaging) may be reported as possible (imputability 1) or probable (imputability 2) TACO depending on supporting features.

In patients in intensive care who may be receiving positive pressure ventilation with varying degrees of positive end expiratory pressure (PEEP), pulmonary oedema may be difficult to diagnose at higher levels of PEEP or indeed become apparent if PEEP is reduced or removed.

There are potential concerns regarding the use of this definition within the United Kingdom where BNP and NT-pro BNP are not routinely available. It is also not routine practice to measure the pulmonary wedge pressure or mean arterial pressure. The MAP can be derived from the systolic (SBP) and diastolic (DBP) blood pressure. MAP=DBP + 1/3 (SBP-DBP).

4. Clinical prioritisation of key features (CPKY)

CPKY is based upon the 'key features' used in the 2013 Annual SHOT Report (Bolton-Maggs et al. 2014) but provides a defined weighting to each of the features to improve reproducibility as described below. Cases can also be classified as 'highly likely' if there is other hard evidence not included in the key feature categories such as post mortem data.

- 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)

For the purpose of this report TACO was considered 'highly likely' with ≥ 3 features, or acute respiratory distress with pulmonary oedema on chest X-ray; 'probable' with respiratory distress and response to treatment for circulatory overload (volume intolerance) and 'possible' with respiratory distress and positive fluid balance.

This definition allows TACO to be considered 'probable' if there is dyspnoea not attributable to another cause that responds to treatment for circulatory overload without the need for imaging. This would fit with hospital practice within the UK to treat the symptoms before imaging is obtained and also allows for the fact that imaging when done is often delayed in the non-emergency setting. Chest X-ray imaging is often reviewed by the treating clinicians in the first instance when a patient is in hospital and therefore there may not be detailed comments recorded such as the cardiac silhouette.

Comparison of results

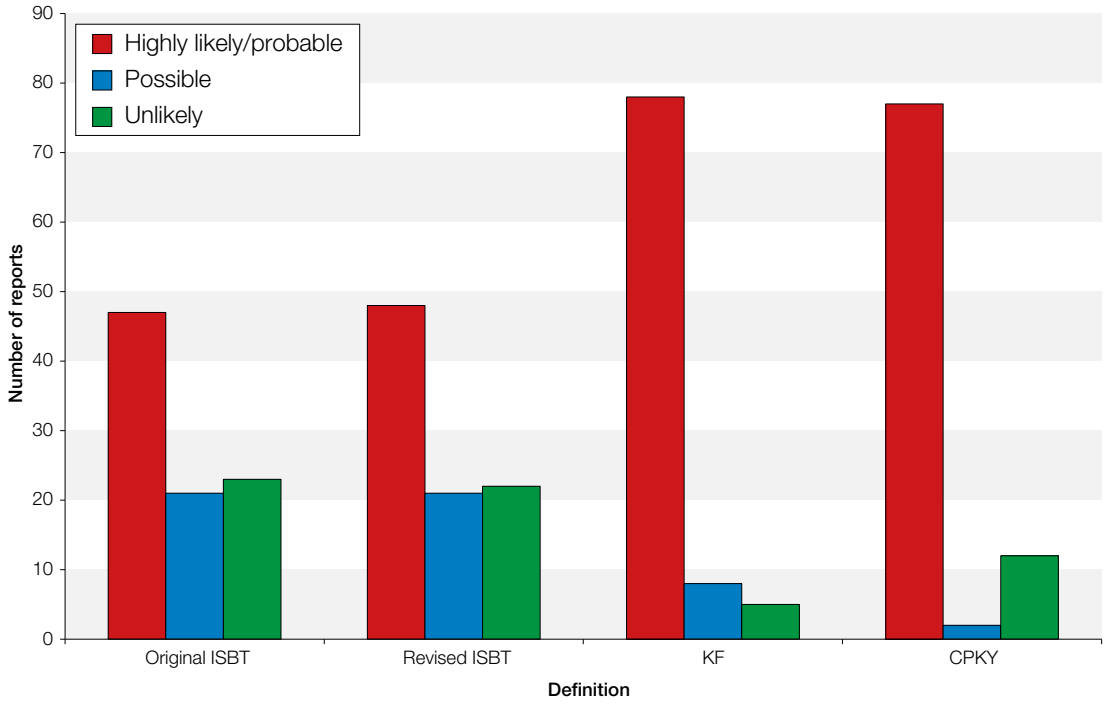
This year 91 cases were submitted for analysis as TACO. Table 19.2 and Figure 19.2 below shows a breakdown of the probability of TACO in each of the cases.

Table 19.2: Probability of TACO by 4 different definitions

	Original ISBT	DRISBT	KF	CPKY
Highly likely	17	39	67	51
Probable	30	9	11	26
Possible	21	21	8	2
Unlikely	23	22	5	12
Total	**91**	**91**	**91**	**91**

The data in Table 19.2 are shown in Figure 19.2 where 'highly likely' and 'probable' cases of TACO have been combined. More cases are considered to be TACO by the definitions using additional clinical features than by the proposed and previous ISBT definitions.

Figure 19.2: Probability of TACO by 4 different definitions



In cases reported to SHOT there remains a high incidence of death and major morbidity which were reported in 42/91 cases (46.2%). It is possible that TACO itself is not always associated with such a high level of morbidity but that the reporting of TACO is much more likely if there was a significant level of morbidity associated with the incident.

TACO cases reported to SHOT include 8 that presented after 6 hours, and 7 after 12 hours.

SHOT reporting demonstrates that approximately half of cases of TACO are seen in association with other intravenous (IV) fluid infusions (42/91, 46.2%) and the majority have pre-existing co morbidities such as pre-existing congestive cardiac failure (59/91, 64.8%).

This year 8 patients received their transfusion in community hospitals or day case units and of these 4 had delayed presentation as the patient was initially discharged, so would be excluded by any definition with a cut-off of 6 hours.

Pre-existing clinical features as risk factors for TACO in small volume transfusions

A total of 15/91 patients (16.5%) received just a single unit of red cells with no other components, 14/15 were considered to be 'probable' or 'highly likely' TACO using the CPKY definition. The median age in this group of 15 patients was 83 ranging from 65-98 years, and 3 patients weighed less than 55kg.

	Single unit transfusion (14 patients)	Overall data (89 patients)*
Fluid overload	8 (57%)	42 (47%)
Cardiac failure	4 (29%)	25 (28%)
Renal impairment	4 (29%)	35 (39%)
Liver impairment	2 (14%)	10 (11%)
Low albumin	1 (7%)	20 (22%)

** No data in 2 cases*

Table 19.3: Pre-existing risk factors in patients receiving single units of red cells

Case scenarios

Below are four cases which highlight different aspects and risk factors for TACO.

Case 3: Communication error

A female patient aged 92 years was on the intensive therapy unit (ITU) and following consultant review a decision was made to transfuse 2 units of blood over 2 days. The blood was then prescribed as 2 units over 2 hours each. A second consultant reviewed the patient and decided to over-rule the initial decision and deemed transfusion unnecessary. However the patient was transferred to a ward with the original prescription (2 units of blood to be transfused over 2 hours). The blood transfusion took place a day later after a review by a third consultant. It is not clear what the third consultant concluded from what has been reported to SHOT but the prescription chart remained unaltered.

The patient developed hypertension and breathlessness 2 hours after completing the second unit of blood. Pulmonary oedema was confirmed on the chest X-ray.

This case highlights the common observation of errors resulting from failures to communicate information. There was an initial communication error and then subsequent decisions were documented but not fully acted upon. The error was not noticed as the patient was transferred to another ward where the patient received the transfusion despite a third review.

The reporter noted that the patient improved following administration of furosemide but with possible prolongation of her hospital stay. This case also highlights the importance of the general advice regarding transfusions not to give 2 without review in patients at risk of TACO. If the patient had been reviewed following the initial unit of blood, perhaps the second unit might not have been given or diuretics could have been prescribed to prevent the resulting pulmonary oedema.

Case 4: Underreporting of TACO, a case identified after the notes were reviewed for other reasons

This 93 year old male was unwell with disseminated intravascular coagulation (cause not reported), congestive cardiac failure (CCF) and a lower respiratory tract infection at the time of the transfusion. The patient was being transfused with FFP during which he developed shortness of breath which improved after treatment with furosemide.

This case was only identified after a review of the notes which was undertaken for other reasons. No chest imaging was requested. This case supports the suspicion that TACO is under-recognised and under-reported.

Cases 5 and 6: Variability in probability of TACO with different decision aids

Case 5: TACO with no imaging

A 94 year old male, known to have underlying pulmonary hypertension, chronic anaemia and a haemoglobin of 91g/L was transfused red cells. Approximately 50 minutes into the transfusion the patient became hypertensive (although the mean arterial pressure was not raised), developed tachycardia and the oxygen saturation dropped. No imaging results were provided; the clinical examination was reported to reveal bibasal crepitations. The patient responded to diuretics and improved following a 700mL diuresis.

This case highlights some of the practical problems of identifying TACO using the different definitions listed above. According to the original ISBT criteria the case is 'probably' TACO (3/5) and the proposed revised ISBT criteria the case is 'possibly' TACO. This case supports the theory that TACO should be considered 'probable' in the context of the clinical situation (dyspnoea with no other likely cause), and a response to treatment for fluid overload. In this case the diagnosis was also supported by the clinical findings submitted to SHOT. This case also highlights the potential for developing TACO in a patient with underlying co-morbidities after a small volume transfusion.

Case 6: Delayed presentation

A 67 year old female patient was transfused with 3 units of red cells as an outpatient and was then readmitted more than 24 hours later with breathlessness, tachycardia, hypotension, fever and rigors. The patient was initially treated with IV fluid and antibiotics with a working diagnosis of infection and a chest X-ray was performed. Once the patient was reviewed by a haematologist on the admission unit the diagnosis was changed to TACO. By this time the chest X-ray had been formally reported and demonstrated pulmonary oedema, the patient had been treated with diuretics. On a repeat chest X-ray the oedema had resolved and the symptoms had improved.

Due to the timings and the treatment in this case it is difficult to give a clear answer whether this was a case of TACO. Both the new and revised ISBT criteria would dismiss the possibility of TACO as the patient presented after more than 12 hours.

The difficulty when applying the 'key features with clinical judgement' criteria (definition 4) is that the patient was initially treated with IV fluids and antibiotics and it is not clear when the first X-ray was taken in relation to this treatment. The X-ray did demonstrate conclusive pulmonary oedema which resolved following treatment with diuretics but the acute respiratory distress could have another cause i.e. infection. It was therefore classified as 'possible' TACO for this report.

Case 7: Difficult diagnosis: TACO or transfusion-related acute lung injury (TRALI)?

A 77 year old lady with a past medical history of hypertension, laparoscopic anterior resection for sigmoid colon cancer was admitted with lethargy, shortness of breath on exertion and poor appetite. On examination she was very pale although haemodynamically stable and clinical examination was essentially normal. She had evidence of significant iron deficiency anaemia with no signs of gastrointestinal (GI) bleeding, Hb 54g/L. Her electrocardiogram (ECG) demonstrated some ST depression in the lateral leads. A diagnosis of severe iron deficiency anaemia secondary to likely recurrence of colorectal cancer was made. The treatment plan was to transfuse 2-3 units of plasma-reduced red cells slowly over a couple of days with other radiological and GI investigations in due course.

Following transfer to a ward, she was transfused the 1st unit of red cells at 18:40 which finished at 23:00 with no major problems. She was independently mobile to the toilet following the transfusion. However, 2 hours later (01:00) she was found to have elevated early warning score (tachycardia, respiratory rate 26 breaths per minute, oxygen saturation 88%, and sounding 'very chesty') and medical help was sought.

She was in severe respiratory distress with rapid deterioration and minimal response to high dose diuretics with severe type 2 respiratory failure. ECG showed no change from earlier, and the chest X-ray was in keeping with possible acute respiratory distress syndrome (ARDS)/severe pulmonary

oedema. She eventually lost cardiac output at 04:40 despite on-going efforts to resuscitate her and died at 05:00. Bloods during the peri-arrest showed acute kidney injury (urea 9.6mmol/L, creatinine 146micromol/L) elevated troponin and Hb 79g/L.

This case highlights some of the difficulties facing clinicians. The patient had significant anaemia and although haemodynamically stable there were subtle ECG changes to suggest possible ischaemia. She was transfused 1 unit of red cells slowly and seemed to be stable immediately after the transfusion. However, she subsequently deteriorated with gross changes on the chest X-ray and continued to deteriorate despite high doses of diuretics. This case was initially submitted as possible TRALI but on review by the expert panel was transferred to TACO. Given the elevated troponin it appears a cardiac event occurred. It is impossible to say when the cardiac event occurred. This is therefore a case of pulmonary oedema which may be due to the transfusion or an alternative cause (cardiac event). However given the timing of the reaction and the timing of the transfusion it appears that the transfusion contributed to the death.

COMMENTARY

From the discussion about the definition of TACO and the cases listed above it remains clear that a formal definition of TACO is hard to achieve. For definite imputability (3) the revised ISBT definition provides the strongest level of evidence but limitations remain regarding its practical application in the UK.

The American National Healthcare Safety Network Biovigilance Component Hemovigilance Module Surveillance Protocol (U.S. Centers for Disease Control and Prevention 2014) uses a two-fold method in the diagnosis of TACO. Firstly the probability of circulatory overload is assessed and considered likely if any 3 of the following are present; acute respiratory distress, elevated BNP, elevated central venous pressure (CVP), evidence of left heart failure, evidence of positive fluid balance or radiographic evidence of pulmonary oedema. Then the imputability of the circulatory overload being related to the blood component is considered. 'Definite' (imputability 3) is considered when no other explanations for circulatory overload are possible. 'Probable' (imputability 2) is when transfusion is a likely contributor and either the patient received other fluids or the patient has a history of cardiac insufficiency that could explain the circulatory overload but transfusion is just as likely to have caused the circulatory overload.

Concerns with the above definition are again the use of BNP and CVP which are not routinely available in the UK and the definition of evidence of left heart failure is not clear. This could mean evidence provided by clinical examination such as bibasal crepitations or peripheral oedema, or it could be based on echocardiogram, all of which are valid clinically. There is also an omission of the response to potential treatment, we have previously found this information to be important in the diagnosis of TACO. This American approach however could provide reassurance to the clinical community that they should report all cases of circulatory overload to SHOT even if they do not think the blood component was the primary cause.

For the purpose of SHOT and other local audits a more pragmatic approach may be of benefit. This would allow cases to be considered as TACO if there was dyspnoea associated with a clinical response to treatment for circulatory overload as in definition 4 (CPKY).

The true extent of TACO remains unclear and further audit or research should be considered. A poster at the 2014 British Blood Transfusion Society Scientific Meeting demonstrated a significant number of TACO cases identified by a case note review which had not been reported to SHOT (Bartholomew and Watson 2014).

References

Bartholomew A and Watson D BBTS Meeting (2014) Abstracts: **Recognition of Transfusion Associated Circulatory Overload in Patients Aged Over 70 Years**. Transfus Med 24, 33–75

U.S. Centers for Disease Control and Prevention (2014) **The National Healthcare Safety Network (NHSN) Manual: Biovigilance Component v2.1.3.** Atlanta, GA: Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases. Available at: http://www.cdc.gov/nhsn/PDFs/Biovigilance/BV-HV-protocol-current.pdf [Accessed 23/01/2015]

Transfusion-Associated Dyspnoea (TAD) n=7

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)

NB: All serious reaction(s) – including transfusion-associated circulatory overload (TACO), and transfusion-associated dyspnoea (TAD) are reportable as SARs to the EU.

Key SHOT message

- Cases of TAD are those which do not fit the criteria for the other pulmonary complications, TRALI or TACO, perhaps because the evidence is not sufficient. Reporters are asked to provide as much information as possible to assist definition. In some cases the pulmonary symptoms result from several factors

In 2014 twelve cases were initially reported including three deaths where the pulmonary complications were implicated, and two cases of major morbidity (defined by admission to ITU and ventilation). Five cases were subsequently transferred to ATR as they had features of allergic response, and one case was transferred to TACO. One case was withdrawn. An additional case was transferred in from the TACO category. The age range was 30 to 79, median age 60 years. Five were female and two were male.

Case descriptions

Case 8: Was this TACO?

One patient, a female aged 57 years transfused following a total knee replacement, may have had TACO but the information about fluid balance was incomplete and there were features suggesting allergy (tight chest with response to bronchodilators). The reaction occurred within the first 2 hours, during transfusion. The patient also had evidence of a chest infection (consolidation on chest X-ray (CXR)). She required admission to intensive care and continuous positive airway pressure (CPAP) within the following 2 days. Pulmonary embolism was excluded by computerised tomography pulmonary angiogram (CTPA).

Case 9: Multifactorial causes for pulmonary symptoms

A female aged 61 years developed shortness of breath 7 hours after completing a platelet transfusion and was transferred to the ITU for ventilation for 48 hours. Her underlying diagnosis was chronic lymphocytic leukaemia (CLL) in transformation with small cerebral bleeds and thrombocytopenia. She already had pneumonia and pre-existing cardiac disease with atrial fibrillation. CXR showed bilateral diffuse lung infective opacities. Investigation for TRALI demonstrated no antibodies in the platelet donor. There was no suggestion of fluid overload.

Case 10: Death in relation to granulocyte transfusion or was it the infection?

A male aged 60 years with neutropenia following a haemopoietic stem cell transplant (HSCT) for acute myeloid leukaemia (AML), developed acute respiratory distress within 24 hours of receiving a granulocyte transfusion associated with rigors. Infiltrates were seen on the CXR. He was ventilated for 8 days but deteriorated despite antibiotics and antifungal treatment. He died, and the adverse reaction to granulocytes was implicated.

Case 11: Breathlessness during transfusion

A woman aged 79 years with pancreatitis developed breathlessness during transfusion at 2 hours. Her Hb was 66g/L before transfusion and she had been febrile at 30 minutes (37.9°C). The reaction was associated with reduced blood pressure (BP) and decreased oxygen saturation, and an increased respiratory rate. She improved after diuretics and gelofusin and all symptoms resolved within 3 hours. There is insufficient detail to be clear what the cause of symptoms was.

Case 12: Death follows a transfusion reaction but the cause is unclear

A 79 year old man under investigation for chronic anaemia developed shortness of breath about 5 hours after completing a unit of red cells. He also had lower back pain and red urine was noted on an incontinence pad. He was transferred to ITU at another hospital where he died. TRALI and haemolytic transfusion reactions were excluded by appropriate testing. CXR showed bilateral infiltrates. He was being investigated for his underlying condition. His blood culture grew Klebsiella. He might have died from infection. Further information noted that the cause of death was 'multi-organ failure with a possible acute transfusion reaction'. No post mortem was performed.

Case 13: Respiratory distress with bronchospasm in a sick woman

A 50 year old woman with alcoholic liver disease was admitted in the early hours with haematemesis and melaena from bleeding varices. She received 4 units of red cells followed by 4 units of FFP over about 11 hours. She was then transfused a further two units of red cells but developed respiratory distress with very severe bronchospasm such that endoscopy was cancelled, she was intubated and ventilated but died after 6 days. There was no evidence of fluid overload or TRALI.

Case 14: A multifactorial reaction?

A 30 year old woman with known asthma and pulmonary metastases from carcinoma of the breast developed tightness of the chest, fever, tachycardia and a fall in her oxygen saturation 2 hours into a transfusion of red cells. This responded well to bronchodilators and antihistamines suggesting that the aetiology was likely to be allergic. This reaction had occurred with previous transfusions.

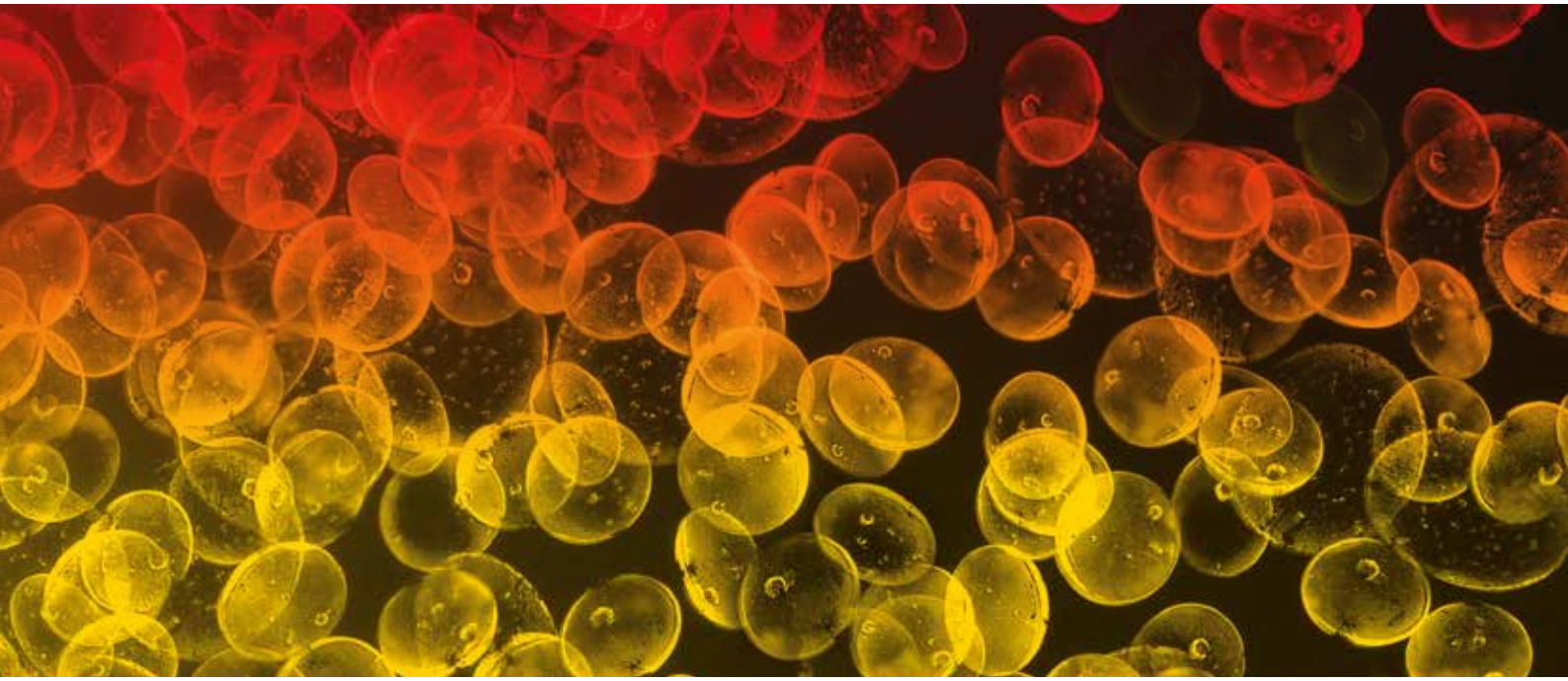
As with other cases in this category it is not possible to be clear what caused this reaction.

COMMENTARY

Patients with underlying disease seem to be more at risk of respiratory complications, perhaps triggered by other components in the transfusion (cytokines, microparticles). SHOT's findings are in contrast to a recent study of 271 patients from Poland (Maslanka et al. 2015) where the majority of reactions (82%) were classified as TAD compared to TRALI (12%) or TACO (6%). However, 85% of the red cell transfusions were non-leucodepleted so that other triggers may have been present.

Reference

Maslanka K, Uhrynowska M et al. (2015) **Analysis of leucocyte antibodies, cytokines, lysophospholipids and cell microparticles in blood components implicated in post-transfusion reactions with dyspnoea**. Vox Sang 108(1), 27-36



Special Clinical Groups

20 Paediatric Cases n=122 (excluding NM and RBRP)

Author: Helen New

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 groups: neonates ≤28 days; infants >28 days and <1 year old; children ≥1 year to <16 years and those aged 16 to <18 years.

Key SHOT messages

- Blood components should be prescribed in volumes for children related to their weight, but not more than the standard accepted dose for an adult
- Patients with suspected DiGeorge syndrome should receive irradiated cellular components until immunodeficiency is excluded, and this should be communicated to the laboratory. There should be local guidelines for the timely investigation of suspected immunodeficiency in order to reduce unnecessary provision of irradiated components
- There has been an increase in the number of severe allergic reactions across all component types reported following paediatric transfusions, although not in the neonatal/infant group

Table 20.1: Summary of paediatric cases 2014

Category of case	28 days	>28 days to <1 year	1 to <16 years	16 to <18 years	Total paediatric cases
Incorrect blood component transfused (IBCT)	11	2	13	3	**29**
Avoidable, delayed or undertransfusion (ADU)	7	3	7	1	**18**
Handling and storage errors (HSE)	5	4	5	1	**15**
Anti-D immunoglobulin errors (Anti-D Ig)	0	0	2	7	**9**
Haemolytic transfusion reactions (HTR)	0	0	1	0	**1**
Acute transfusion reactions (ATR)	2	2	32	7	**43**
Alloimmunisation (Allo)	0	0	1	0	**1**
Transfusion-associated circulatory overload (TACO)	0	0	3	0	**3**
Transfusion-related acute lung injury (TRALI)	0	0	1	0	**1**
Unclassifiable complications of transfusion (UCT)	2	0	0	0	**2**
Total	**27**	**11**	**65**	**19**	**122**
Near miss (NM)	37	15	31	7	**90**
Right blood right patient (RBRP)	5	1	2	1	**9**

Introduction and overall trends

The overall number of paediatric reports was up from 185 in 2013 to 221, or 122 excluding near miss (NM) and right blood right patient (RBRP). Paediatric cases made up 122/1681 (7.3%) of total SHOT reports in 2014, and 221/3017 (7.3%) if NM and RBRP are included, slightly more than in 2013 (6.5% of total reports). Neonatal case reports have gradually increased over the last 5 years which may reflect increasing awareness among clinicians. The neonatal cases include two adverse incidents occurring during exchange transfusions. However this year there were no reports to SHOT of transfusion-associated necrotising enterocolitis although this condition is described in the UK (Hamad et al. 2015), and should be reported to SHOT.

In 2014 there was a striking increase in ATR reports in children from 1 year of age (compared to a reduction over the last two years) particularly in the numbers of severe allergic reactions, with ATRs a higher percentage of paediatric reports (35%) compared with total cases (20%) (Figures 20.1, 20.2). There were three reports of TACO.

Error-related reports (IBCT, HSE, ADU and anti-D Ig) were a similar number and distribution as in 2013 at 58.2% (71/122) of all paediatric reports. Errors were recorded for 84.2% (32/38) of reports from infants <1 year old. A total of 25/71 (35.2%) errors originated primarily in the laboratory (4 IBCT-wrong component transfused (WCT), 8 IBCT- specific requirements not met (SRNM), 5 HSE, 7 ADU, 1 anti-D Ig).

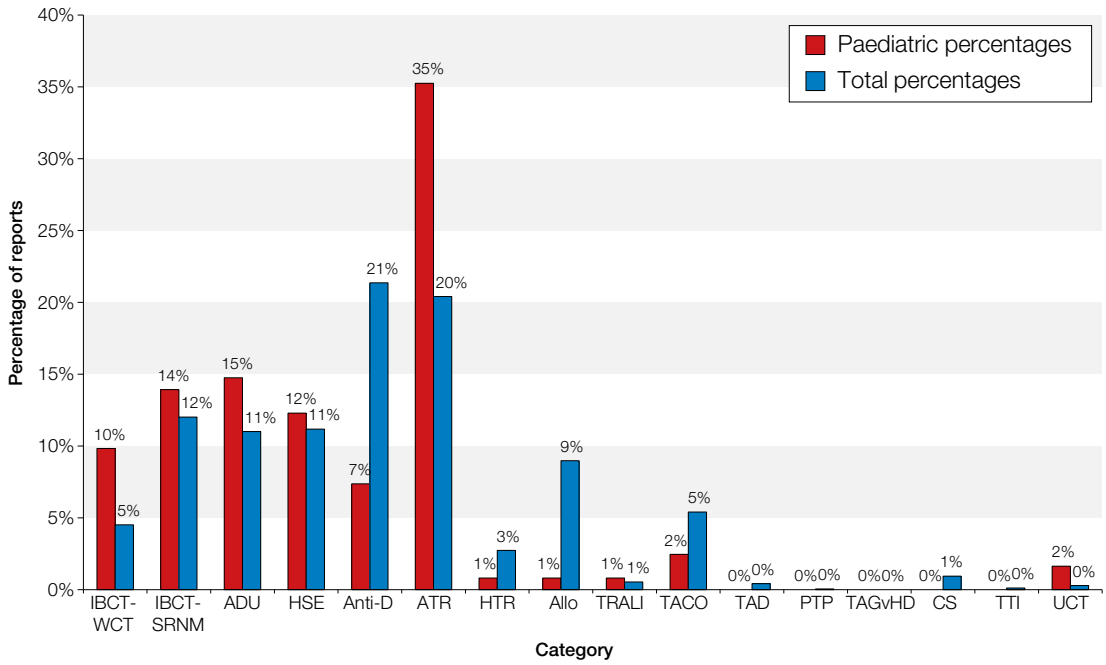
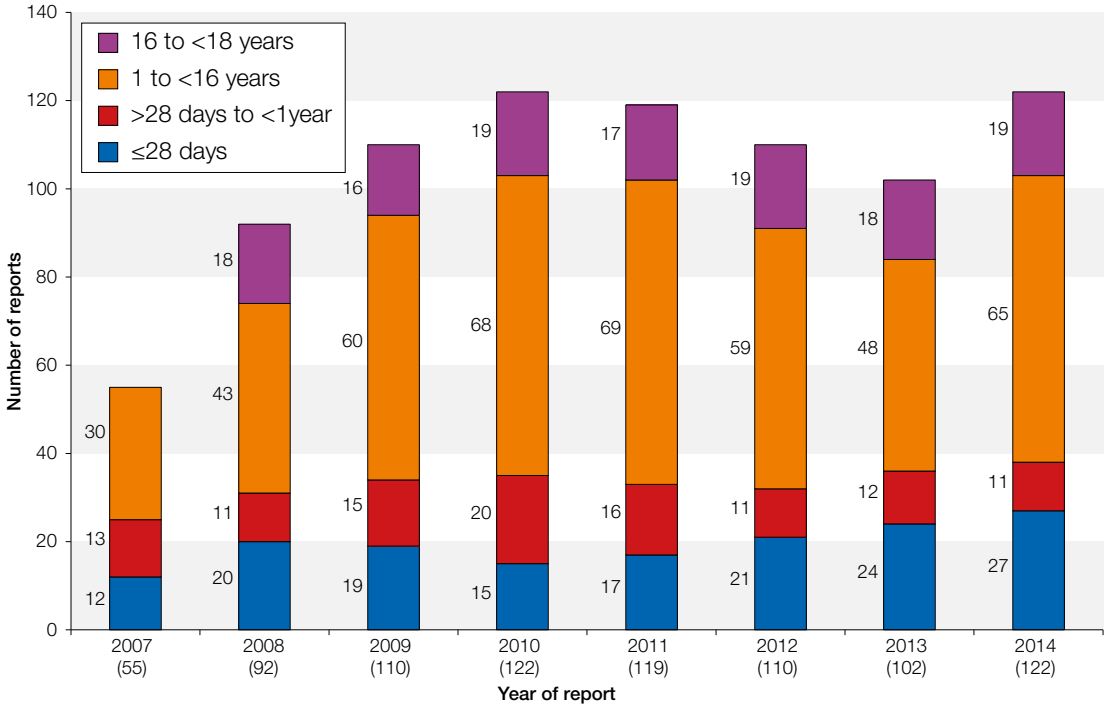


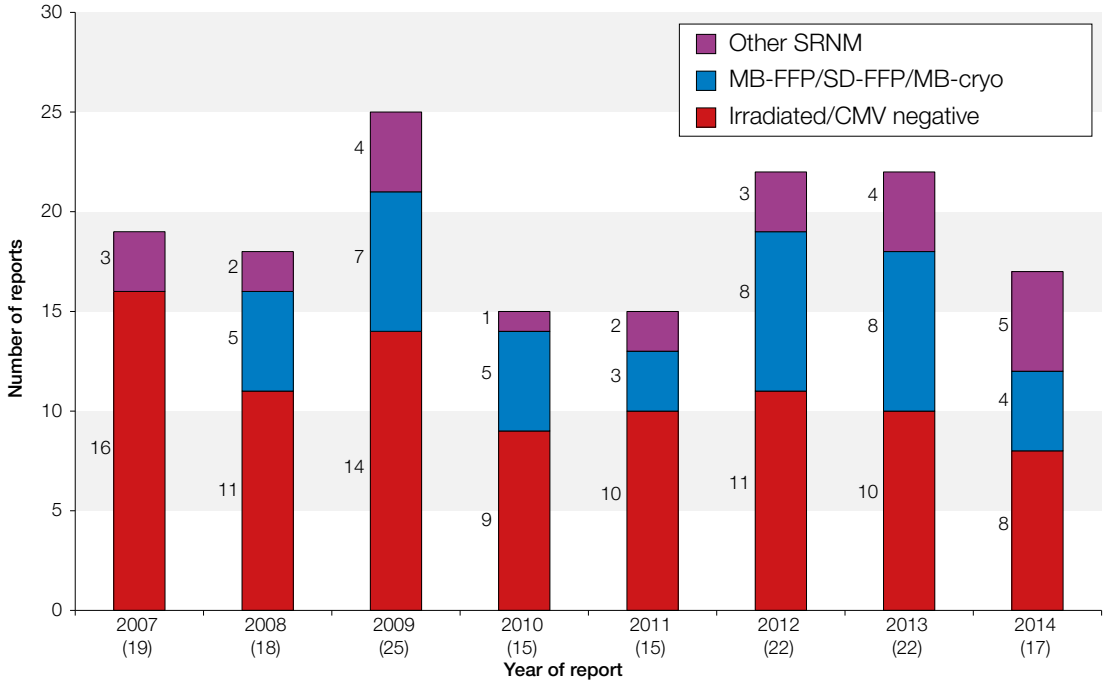
Figure 20.1: Percentages of paediatric and total reports in each category

Figure 20.2: Trends in paediatric reports 2007-2014

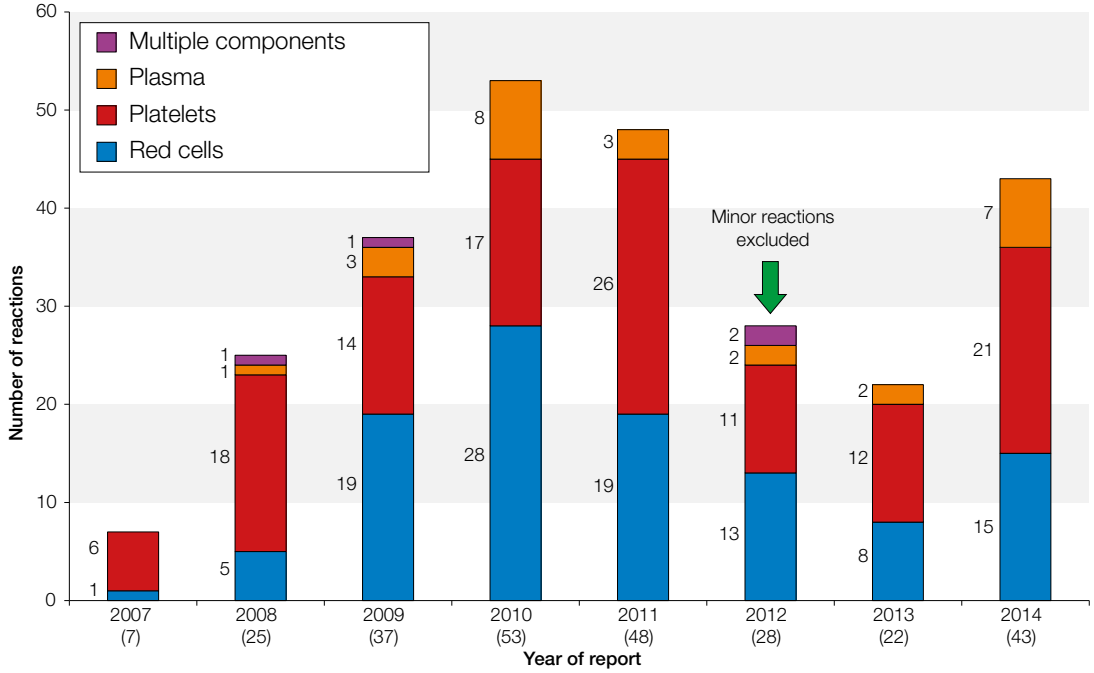
a. Total numbers of paediatric reports (excluding RBRP and NM reports)



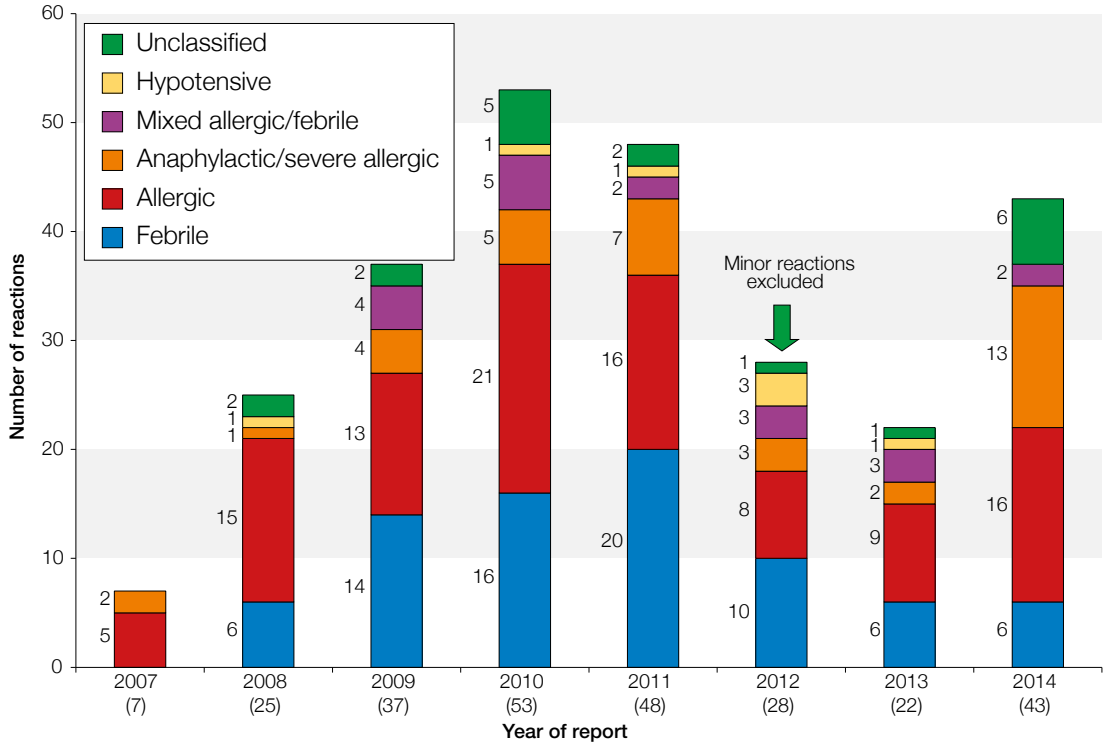
b. Paediatric reports where specific requirements were not met



c. Paediatric acute transfusion reaction reports by component type



d. Paediatric acute transfusion reaction reports by reaction type



Note: in 2007 only cases <16 years were included

Deaths due to transfusion n=0 (deaths unrelated to transfusion n=5)

There were 5 deaths in neonates [including 1 NM], unrelated to transfusion.

Major morbidity n=24

Major morbidity occurred in 18 severe ATRs, 1 HTR, 2 TACO, 1 TRALI and 2 unclassifiable complications of transfusion.

Error-related reports n=71

Incorrect blood component transfused (IBCT) n=29

Table 20.2: Breakdown of incorrect blood component transfusion reports

Category of case	≤28 days	>28 days to <1 year	1 to <16 years	16 to <18 years	Total paediatric cases
IBCT: wrong component transfused (IBCT-WCT)	8	0	4	0	**12**
IBCT-WCT Clinical	*6*	*0*	*2*	*0*	*8*
IBCT-WCT Laboratory	*2*	*0*	*2*	*0*	*4*
IBCT: specific requirements not met (IBCT-SRNM)	3	2	9	3	**17**
Irradiated	*1*	*2*	*4*	*1*	*8*
CMV negative	*0*	*0*	*0*	*0*	*0*
MB- or SD-FFP	*0*	*0*	*2*	*2*	*4*
Others	*2*	*0*	*3*	*0*	*5*
Total	**11**	**2**	**13**	**3**	**29**

MB: Methylene blue-treated SD: solvent-detergent treated CMV: cytomegalovirus

IBCT-wrong component transfused (WCT) n=12

IBCT-WCT clinical error n=8

Six neonates were transfused with the wrong component.

- Three newborn babies received urgent transfusions on the neonatal intensive care unit (NICU) using adult emergency O D-negative blood (i.e. not CMV screened), due to collection errors and lack of awareness
- One emergency transfusion in theatre: a baby was transfused blood intended for the mother
- Two neonates received blood intended for other babies due to a failure of bedside checking, although compatible O D-negative blood was transfused

Two older children received an incorrect group of either red cells or platelets following haemopoietic stem cell transplant (HSCT) due to poor communication between clinicians and laboratory staff, in one case following patient transfer between hospitals.

No adverse outcomes were reported in relation to any of these wrong transfusions.

IBCT-WCT laboratory error n=4

A newborn baby was issued and transfused with MB-cryoprecipitate instead of MB-FFP.

A one-month old D-negative baby girl was erroneously transfused with group O D-positive red cells.

Case 1: Transfusion of D-positive red cells to a D-negative female infant – multiple errors

A group B D-negative female neonate (premature 24/40) was transfused 10.5mL of O D-positive red cells. This was detected 9 days after the transfusion without any morbidity. The laboratory information management system (LIMS) put up a warning flag during component issue but this was overridden by the biomedical scientist during a late shift when they were rushing to complete the work. Other errors occurred during the collection from the refrigerator and the final bedside administration check.

A 9 year old boy was transfused with red cells of the wrong group following HSCT due to failure to check historical information in the laboratory, although there was no adverse outcome. He himself pointed out the error.

A 14 year old with newly diagnosed acute leukaemia, a Hb of 28g/L and red cell antibodies required an emergency red cell transfusion. Although the recommendation was to transfuse 'suitable but not compatible' blood until there had been investigation of the antibodies, the ward staff took emergency group O D-negative red cells due to a misunderstanding with the laboratory.

IBCT: specific requirements not met (SRNM) n=17

There were eight failures to give irradiated components, largely due to clinical error, with no adverse outcomes.

- Three were in patients ≤2 years old undergoing cardiac surgery with suspected or diagnosed DiGeorge syndrome: in two of these the requesting clinicians did not realise that irradiated components were required and in the third the patient's laboratory record had not been amended appropriately
- A young infant was transfused in the neonatal unit for anaemia following an intrauterine transfusion (IUT) as the laboratory scientist ignored a flag on the LIMS
- A 1 year old with suspected immunodeficiency did not have irradiated components requested
- Three older children who did not have irradiated components requested included one detected as part of a lookback exercise with Hodgkin lymphoma, and a teenager post HSCT undergoing cardiac surgery

Case 2: Missed requirement for irradiated components for DiGeorge syndrome

A 4 day old baby with a hypoplastic left heart and suspected DiGeorge syndrome underwent cardiac surgery and received several non-irradiated red cell components (including units for pump priming) as the junior doctor had informed the laboratory that the patient did not require irradiated components. At a later date when the patient was put onto extracorporeal life support it was realised that the patient should be receiving irradiated components.

DiGeorge syndrome may be associated with a T-cell immunodeficiency and in suspected cases patients should be given irradiated components until the syndrome is excluded (BCSH Treleaven et al. 2011).

The four cases of failure to provide MB- or SD-FFP all occurred in children ≥12 yrs old, who would receive adult-sized FFP units. These were all urgent/emergency transfusions in the setting of massive transfusion or acute blood loss, and all were due to laboratory errors with failure to select MB-FFP units because the LIMS system did not flag that MB- or SD-FFP should be used. In one case this was partly due to the way that the request was entered.

There were 5 errors in laboratory pre-transfusion testing or component provision.

- In one case of inadequate red cell compatibility testing in a neonatal/young infant a direct antiglobulin test was not performed on the pre-transfusion sample
- A 5 year old was issued with red cells prior to the crossmatch result having been read due to a failure to follow procedure
- In three cases components of specific phenotype were not provided. A newborn baby with suspected neonatal alloimmune thrombocytopenia was transfused with random neonatal platelets instead of human platelet antigen (HPA) 1a- 5b-negative platelets due to poor communication with the laboratory. Two children with sickle cell disease were issued with blood that was not matched for Rh phenotype, and one subsequently developed anti-C following the transfusion.

Avoidable, delayed or undertransfusion (ADU) n=18

Avoidable transfusion n=9

A preterm newborn baby with a normal platelet count was transfused platelets before the result was available because of bruising at birth and because the child was born to a mother who was receiving platelets while undergoing treatment for leukaemia.

There were 7 cases of transfusion based on incorrect pre-transfusion results, including a 2 day old baby transfused with cryoprecipitate based on an incorrect fibrinogen result due to a faulty machine in the laboratory and a 5 day old baby transfused prophylactic platelets for a platelet result of $20x10^9$/L, released despite platelet clumps in the sample. An acutely unwell 9 day old baby was transfused red cells on the basis of a blood gas machine Hb of 56g/L, until the laboratory result of 188g/L was received. A preterm baby was given a routine top-up transfusion of red cells for a Hb result of 89g/L but had already been transfused in the meantime.

Case 3: Transfusion following result transcription error

A child undergoing treatment for a brain tumour was transfused 2 units of red cells prior to transfer to the paediatric oncology centre for HSCT. The Hb was 107g/L but had been poorly transcribed on the results flow sheet and was read as 67g/L without checking further despite the previous day's result of 97g/L.

A child was transfused platelets for a low platelet count, based on a mislabelled sample from another patient. The child had an allergic reaction to the unnecessary platelet transfusion. These cases highlight the need for care in scrutiny and clinical interpretation of results.

A needle-phobic 17 year old undergoing surgery was to have had the group and save sample under anaesthetic but this was omitted. As there was no valid sample in the laboratory, major postoperative bleeding necessitated transfusion with group O red cells.

Delayed transfusion n=5

Two babies in theatre had significant delays in platelet transfusion due to miscommunication and non-availability of platelets. A preterm baby requiring an irradiated red cell transfusion was given non-irradiated red cells due to problems with the local irradiator. There were two cases of delayed platelet transfusions to children following HSCT due to confusion related to blood grouping.

Overtransfusion n=4

These cases were overtransfused either for the rate or volume of blood components (2 of these are described as prescribing errors in Chapter 10 Avoidable, Delayed or Undertransfusion).

- Two units were given overnight to a 23.5kg child following bleeding and the Hb rose from 80 to 172g/L
- A 3.3kg infant with haemolytic disease of the newborn was prescribed 16mL/kg red cells to run at 10mL/kg/hr, approximately twice as fast as the standard accepted rate and the baby had a raised temperature and respiratory rate during the transfusion
- A 36.5kg child was transfused with 365mL platelets (10mL/kg), a volume greater than one platelet pack

Handling and storage errors (HSE) n=15

There were no adverse outcomes of the HSE reports. There were 7 reports of transfusions administered over the incorrect time, 4 resulted from errors with the neonatal pump.

- For one baby the infusion pump had an option to 'continue' rather than 'stop' and the transfusion continued for 4 rather than 3 hours

- There were two reports in older children of administration errors due to incorrect settings: one set at 110mL/hr instead of 11mL/hr for transfusion of a paedipack to a 1 year old, and another set to transfuse the entire 204mL red cell unit rather than the 154mL prescribed
- A platelet transfusion to a 10 year old took 4 hours due to problems with a central intravenous line
- In another administration error to a neonate, SD-FFP was transfused through the same venous access as morphine

There were 7 errors in component storage for paediatric recipients, including platelets transfused to a neonate having been placed in a refrigerator on the advice of the blood transfusion laboratory. A split red cell pack was issued for a 7 month old infant, but not taken back into stock after 72 hours, and instead was left in a satellite refrigerator for 2 weeks during which time 2 further units were transfused (as if it were a paedipack being transfused to an infant less than 4 months old).

Anti-D Ig n=9

Eight of the 9 anti-D Ig cases were related to pregnancy in teenage girls. There was also a 2 year old D-negative girl given D-positive human leucocyte antigen (HLA)-matched platelets without consideration that she should also receive anti-D Ig (see Case 2, Chapter 25 in the 2014 Annual SHOT Report: Web Edition on the SHOT website, www.shotuk.org under SHOT Annual Reports and Summaries).

Transfusion reactions n=51

Acute transfusion reactions (ATR) n=43

There were almost double the number of acute transfusion reactions reported in paediatric patients compared to 2013. These made up 12.5% (43/343) of all ATR reports (6.9%, 22/320 in 2013). The number and proportion of severe reactions reported for paediatrics were also increased (now similar to total ATR reports): 18/43 (41.9%). Of these 13/18 were severe allergic/anaphylactic reactions, compared to 3/21 (14.3%) of those assessable in 2013.

Severe reactions: 6/18 to red cells, 7/18 to platelets (all allergic), and 5/18 to plasma.

There was no change in the percentages of ATRs overall to different component types from previous years: 15 to red cells (34.9%), 21 to platelets (48.8%), and 7 to plasma (16.3%) (6 FFP,1 cryoprecipitate) (Figure 20.2c).

Red cells: the reactions were mostly febrile or allergic (4 severe).

There were 2 severe unclassified ATRs during red cell transfusion: a 26 week fetus developed severe bradycardia and required urgent delivery following an intrauterine transfusion, and a one-month old infant developed profound apnoea and bradycardia requiring ventilation 9 hours following an uneventful transfusion.

Platelets: nearly all were allergic, 7/21 (33.3%) severe allergic/anaphylactic.

Plasma components: there were 7 reactions to plasma: 5 to MB-FFP (two in the same patient), 1 to standard FFP and 1 following cryoprecipitate. Five of 7 reactions to plasma were severe (3 to MB-FFP, 1 to standard FFP and 1 to standard cryoprecipitate), of which 4 were severe allergic/anaphylactic and one was unclassified. There were no paediatric reports of reactions to SD-FFP.

Case 4: Clinical deterioration following MB-FFP transfusion to a neonate

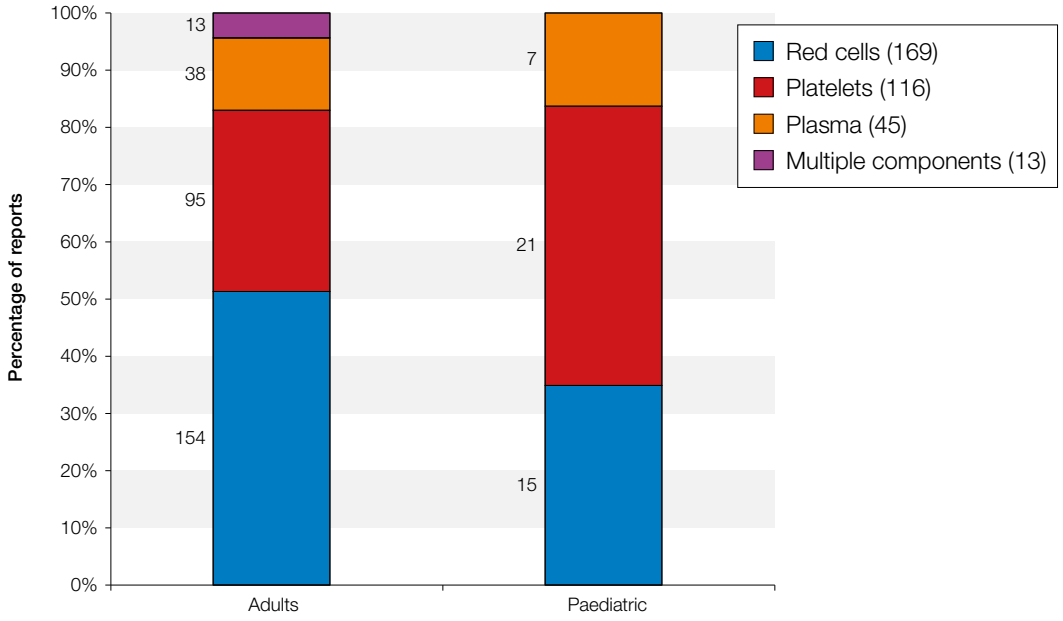
A septic, preterm neonate (29 weeks gestation) developed bradycardia, became hypotensive and desaturated during transfusion of FFP. The transfusion was stopped and the baby required adrenaline and hand ventilation for a few minutes before stabilising back on the ventilator.

Other reactions to plasma:

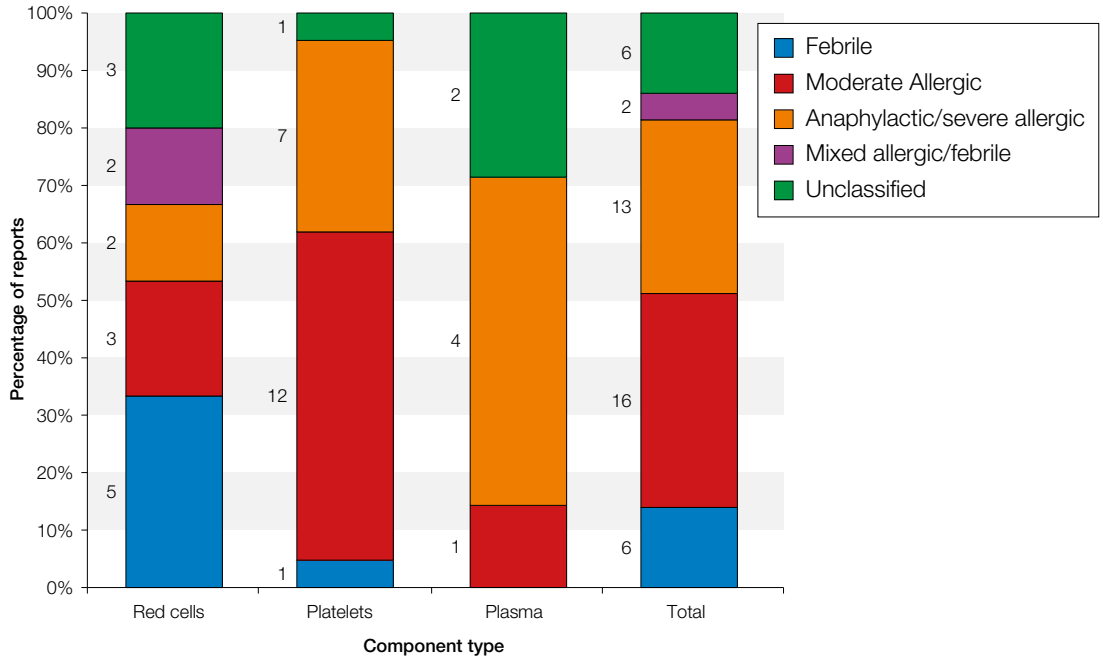
- A patient with a single factor deficiency had two MB-FFP reaction reports (including 1 severe allergic) He/she was being treated with FFP in the community, and had also experienced a severe allergic reaction to SD-FFP in the past
- An 11 year old had a moderate allergic reaction to MB-FFP
- A 16 year old had a severe allergic reaction when given MB-FFP for treatment of disseminated intravascular coagulation (DIC)
- Another 16 year old with a coagulopathy prior to surgery had a severe allergic reaction, either to standard FFP or to the anaesthetic agent
- An anaphylactic reaction occurred in a 17 year old in association with a transfusion of standard cryoprecipitate for DIC following trauma and massive haemorrhage. The patient had also received red cells and MB-FFP prior to the cryoprecipitate

Figure 20.3: Paediatric ATR reports

a. Comparison of proportions of adult and paediatric ATRs related to different components



b. Percentages of reaction types for each component for paediatric reports.



Haemolytic transfusion reactions (HTR) n=1

An 8 year old with sickle cell disease developed hyperhaemolysis with jaundice and intravascular haemolysis 6 days post transfusion for tonsillectomy.

Alloimmunisation (Allo) n=1

A 14 year old transfused on the intensive care unit developed anti-Fy^{a} following transfusion.

Transfusion-associated circulatory overload (TACO) n=3

All three patients with TACO had paediatric malignancies and were also receiving other fluids.

- A 1 year old had a raised blood pressure following transfusion of an adult sized unit of red cells and the Hb rose from 79g/L before transfusion to 149g/L after transfusion
- Two children developed respiratory complications compatible with fluid overload following prophylactic platelet transfusions and required ventilation on paediatric intensive care

These cases emphasise that TACO needs to be considered in children as well as adults, particularly in those already receiving other fluid therapy.

Transfusion-related acute lung injury (TRALI) n=1

A 1 year old paediatric oncology patient had a respiratory deterioration several hours following a prophylactic platelet transfusion and chemotherapy. Although TRALI was reported, this was subsequently felt to be unlikely.

Unclassifiable complications of transfusion (UCT) n=2

There were no cases of transfusion associated necrotising enterocolitis reported for 2014.

There were two unclassifiable complications in day 1 neonates undergoing exchange transfusion for haemolytic disease of the newborn due to maternal anti-D.

- One neonate collapsed after 345mL blood had been transfused and it was subsequently discovered that both umbilical lines being used for the procedure were arterial. The baby responded well to fluid resuscitation and the event was considered possibly due to arterial spasm
- The second baby collapsed with a respiratory arrest after only 50mL had been transfused. The cause of the collapse was uncertain although there were problems with blood flow during the exchange procedure. The baby was successfully resuscitated with a bolus transfusion of blood from the same unit

Both these cases illustrate the complexity of neonatal exchange transfusions and that there are inherent risks associated with the procedure itself.

Near miss (NM) n=90 and right blood right patient (RBRP) n=9

Neonates were involved in 37/90 (41.1%) paediatric near miss cases with errors including maternal and cord/baby sample transpositions.

Reporting reminders

Please continue to report cases of transfusion-associated necrotising enterocolitis (NEC).

Transfusion-associated necrotising enterocolitis (TANEC) occurs in premature neonates. Necrotising enterocolitis is a serious disorder which in some cases appears to be triggered by red cell transfusion. Two cases were reported to SHOT in 2011 and we will continue to accept these. Please report them under the 'Uncategorised Complications of Transfusion' category. Published data suggest that 27-38% of NEC cases are transfusion-related. These are defined as those occurring within 48 hours of red cell transfusion (Gephart 2012).

COMMENTARY

Most types of paediatric errors reported to SHOT for 2014 are the same as those highlighted in previous reports, such as the use of adult emergency O D-negative blood for neonates. Confusion over blood grouping for HSCT patients is a recurring problem for children as well as older patients (see Chapter 22 Summary of Incidents Related to Transplant Cases). Prescribing in mL for children rather than units is recommended to increase safety by reducing the risk of overtransfusion and circulatory overload. However, attention should also be paid to not transfusing more than the standard accepted dose received by an adult, for example a single pack of platelets in most situations.

The recommendation (BCSH, Treleaven et al. 2011) that patients with suspected DiGeorge syndrome should have irradiated cellular components until immunodeficiency is excluded can cause problems in red cell provision for paediatric cardiac centres, particularly in emergencies and where large volume transfusions are indicated. It is important for clinicians to be aware of the requirement and that this is communicated to the blood transfusion laboratory in a timely way, including the removal of the requirement for irradiation if immunodeficiency is excluded. There should be local policies giving guidance on the investigation of immunodeficiency in these patients.

There was a striking increase in the number of paediatric ATR reports, in particular severe allergic reactions, across all component types. This increase was more marked than in total ATR reports; the reason is unclear and not seen in the neonatal/infant age group. It emphasises the need for careful assessment of the risk/benefit balance prior to transfusion. There were cases of collapse associated with red cell transfusion in neonates and also in a fetus following an IUT (see both ATR and UCT sections). The complex nature of the procedures themselves is likely to contribute to the morbidity in these cases and neonatal exchange transfusions are the subject of current survey in association with the British Paediatric Surveillance Unit (www.rcpch.ac.uk/bpsu/ebt).

There were severe ATRs to both MB-FFP and standard plasma but none to SD-FFP in the paediatric group. An analysis of SHOT reports from 2007-2013 comparing reactions to MB-FFP with those to standard FFP has shown no difference for all ATRs and no difference in either non-severe or severe allergic/anaphylactic reactions. Severe hypotensive reactions were significantly higher for MB-FFP than standard FFP but the absolute numbers of cases were very small (4 MB-FFP hypotensive cases, all ≤13 months old) and the clinical significance is uncertain, and may reflect differences in recipient patient groups (New et al. 2015).

References

BCSH Treleaven J, Gennery A et al. (2011) **Guidelines on the use of irradiated blood components, prepared by the British Committee for Standards in Haematology blood transfusion task force**. Br J Haematol 152, 35–51. doi: 10.1111/j.1365-2141.2010.08444 http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2141.2010.08444.x/full [Accessed 12/03/2015]

Gephart SM (2012) **Transfusion-associated necrotizing enterocolitis (TANEC): Evidence and uncertainty**. Adv Neonatal Care 12(4), 232-236

Hamad S, Jones K, et al. (2015) **UK transfusion-associated necrotising enterocolitis cases identified through a multicentre audt**. Arch Dis Child 100: Suppl 3 A55 doi:10.1136/archdischild-2015-308599.124

New HV, Tinegate H, Curnow E, Bolton-Maggs PHB, Cardigan R (2015) **Analysis of acute transfusion reaction rates to fresh-frozen plasma and platelet components in the UK**. Vox Sang abstract in press.

Update on Transfusion Complications in Patients with Haemoglobin Disorders n=35

21

Author: Paula Bolton-Maggs

Key SHOT messages

- People with haemoglobin disorders are vulnerable to transfusion complications. It is vital that clinical staff inform the laboratory of the diagnosis so that the optimal components are selected
- Hospitals are encouraged to report cases of hyperhaemolysis to the expert panel and to SHOT (see additional key messages about hyperhaemolysis at the end of the chapter)
- The advice not to transfuse at night issued by SHOT in previous years has been revised as it is in the interests of patients receiving regular transfusion to reduce time lost to education or employment. It is essential that the standard of care during transfusion is the same at whatever time a transfusion takes place (see Chapter 5 Key Messages)

Category	Sickle cell disease (SCD)					Total 5 yrs	Outcome
	2010	2011	2012	2013	2014		
HTR	4	5	7	16	**11**	**43**	2 deaths, 20 MM
SRNM	3	6	7	7	**6**	**30***	1 alloimmunisation
ATR	4	3	2	2	**1**	**12**	Minor morbidity
NM	2	2	0	1	**6**	**11**	
ADU	0	1	1	2	**0**	**4**	2 deaths
TACO	0	1	0	0	**1**	**2**	1 MM
TAD	0	1	0	0	**0**	**1**	
TTI	0	0	1	0	**0**	**1**	Parvovirus

Category	Beta thalassaemia major					Total 5 yrs	Outcome
	2010	2011	2012	2013	2014		
HTR	0	0	0	0	**1**	**1**	1 MM
SRNM*	0	2	2	1	**1**	**6**	
ATR	6	3	3	2	**2**	**16**	Minor morbidity
NM	0	0	1	0	**0**	**1**	
ADU	0	0	0	0	**1**	**1**	
TACO	0	0	0	0	**1**	**1**	
IBCT	0	0	2	0	**1**	**3**	Two ABO-incompatible transfusions

Table 21.1: Adverse clinical incidents in haemoglobinopathy patients – cumulative data for 5 years (2010-2014) (Excluding alloimmunisation, handling and storage and right blood right patient errors as there were no clinical adverse outcomes.)

(MM=major morbidity; ATR=acute transfusion reactions; HTR=haemolytic transfusion reactions; TACO=transfusion-related circulatory overload; TAD=transfusion-associated dyspnoea; ADU=avoidable, delayed or undertransfusion; 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)

**This total includes an additional woman in 2012 with HbH disease who did not receive CMV-screened blood because the clinicians did not inform the laboratory that she was pregnant, and a lady with HbC disease transfused for menorrhagia in 2014 where the laboratory was not informed.*

A total of 35 cases were reported in patients with haemoglobin disorders in 2014. The median age of the patients was 28.5 years, range 8 to 53 years. Haemolytic transfusion reactions were the most significant complication in people with sickle cell disease (SCD). SHOT is hoping to improve the understanding of hyperhaemolysis by offering a consultative service as described last year. Clinicians are invited to contact the expert team directly (for patients in England via the National Health Service Blood and Transplant (NHSBT) consultant on call) for advice on acute management of these patients. Reports should then be made anonymously to the haemolytic transfusion reaction category in SHOT as usual. In 2014 there were four confirmed cases of hyperhaemolysis reviewed by the expert panel, and other cases of possible hyperhaemolysis which are reviewed in Chapter 15 Haemolytic Transfusion Reactions (HTR).

As in previous years, patients with SCD were more likely to have adverse reactions than those with beta thalassaemia.

Haemolytic transfusion reactions

These were reported in 11 patients with SCD and further details are given in Chapter 15 Haemolytic Transfusion Reactions (HTR). There were no deaths attributable to this complication but 3 patients suffered major morbidity.

Case 1: A reminder about shared care

A woman aged 32 with SCD was scheduled for removal of retained products of conception. She had received 4 units of red cells 16 days previously and subsequently developed evidence of delayed haemolysis. She was found to have 4 alloantibodies. She had received appropriate Rh and K phenotype. The previous transfusion history was not known at this hospital. Her care was shared between 2 hospitals so the other was made aware of these findings.

There was also one serious HTR in a thalassaemia patient.

Case 2: Severe HTR in a patient with thalassaemia

A 52 year old woman with beta thalassaemia major was already receiving washed red cells. She reacted at the end of a second unit with rigor, hypertension, pyrexia and haemoglobinuria. She required admission and was kept in for 5 days. No alloantibodies were detected by extensive investigation but a pan-reactive autoantibody was found 17 days later. She has since been transfused without event but all pre-transfusion samples are referred to the Blood Service.

Alloimmunisation

Alloimmunisation was reported in 2 cases.

Case 3: Alloimmunisation after an inappropriate transfusion to a woman with beta thalassaemia trait

A 24 year old woman who was 8 weeks pregnant was transfused in a gynaecology department on the basis of a Hb 85g/L. This was an unnecessary transfusion which resulted in the development of anti-c and anti-E.

Transfusion-associated circulatory overload

Case 4: TACO after delivery

A woman aged 31 with beta thalassaemia trait was transfused in the delivery ward. Her Hb was <70g/L a few days after a postpartum haemorrhage. This patient was already receiving diuretics for fluid overload before transfusion, and during the 2nd unit became breathless with an increase in respiratory rate from 21 to 40 breaths per minute requiring oxygen support. Details of fluid balance were not available.

Avoidable, delayed or undertransfusion

Case 5: Avoidable transfusion caused by wrong haemoglobin result from a different patient

A woman with beta thalassaemia major aged 21 received an unnecessary transfusion as a result of a 'wrong blood in tube' haemoglobin result. Her true result was 122g/L, and the wrong result from another patient was 87g/L. She received 3 units of red cells and post-transfusion Hb was 157g/L. This error occurred because the blood samples were labelled away from the patient, and is particularly unfortunate in a patient already susceptible to iron overload.

Acute transfusion reactions

ATRs were reported in 3 patients, age range 13-49 years, 2 with beta thalassaemia major.

Specific requirements not met

There were 7 reports:

- 4 were laboratory errors where incorrect phenotypes were issued for patients with sickle cell disease
- There were 3 clinical errors
  - A patient with SCD was admitted through the emergency department (ED) and given a new number which did not link to a previous record of known anti-Fy3
  - A woman with HbC disease who had never been transfused and was registered with a haematologist at another hospital was admitted with severe menorrhagia and transfused without informing the laboratory about this diagnosis. At the hospital where she was known there was a note of her specific requirements, to receive C-negative, K-negative and Fy^b-negative units
  - A woman aged 39 years received a 2-unit transfusion after caesarean section without specific phenotype as the clinical staff failed to inform the laboratory that she had SCD

Case 6: Confusion after allograft for beta thalassaemia major

A 9 year old boy had received an allogeneic haemopoietic stem cell transplant (HSCT) for beta thalassaemia major in 2009. His original group was O D-positive, and the allograft donor was B D-positive. Transfusion was started with a B D-positive unit but the patient said he usually received O D-positive blood. Review of the records showed that he had lost his graft. Group check showed him to be weak B D-positive with no anti-B but it was decided to continue with O D-positive red cells. There was a note on the laboratory system that the patient should receive O D-positive red cells.

COMMENTARY

As noted before, people with haemoglobin disorders are vulnerable to a variety of transfusion complications related to the frequency of exposure to foreign antigens and reflecting the different origin of donor phenotypes.

A 5-year review of 637 adult patients with SCD at a single centre reported 23 delayed haemolytic transfusion reaction (DHTR) events in 17 patients (7.7%); 4 patients had recurrent events (Vidler et al. 2015). An interesting observation in this study was that 20/23 (87%) followed transfusion for an acute event where a patient was admitted to an acute medical ward. This reflects other reports of the association between inflammation and induction of irregular antibodies (Fasano et al. 2015). It was notable in Vidler's study that overall 47.8% of these reactions were not recognised at the time and were thought to be vaso-occlusive events (as has previously been noted in SHOT case reports) and the authors recommend that DHTR should always be excluded in recently-transfused patients who present with pain.

The UK Thalassaemia Society noted that, despite their good practice guidelines, some hospitals have not been sympathetic to performing elective transfusions out-of-hours in those on regular transfusion regimens. This may be based on the previous SHOT recommendation not to transfuse at night. We

have revisited this recommendation and modified it as detailed in Chapter 5 Key Messages. However, since these patients may have antibodies and specific phenotype requirements the crossmatching is better performed in advance in normal working hours. We hope that this will facilitate improved access for these patients but it is important that the standard of transfusion practice and monitoring should be the same whatever time of day or night it takes place.

Hyperhaemolysis is poorly understood. Cases may be discussed as soon as recognised with the expert panel who will collect key data on a proforma, and should also be reported (anonymously as usual) to SHOT. Four cases were confirmed in the second half of 2014 once the reporting mechanism was set up. We do not know the long term outcome and will be adding a 12-month follow up to discover the transfusion management subsequent to a diagnosis of hyperhaemolysis, as transfusion is thought to be dangerous.

Hyperhaemolytic transfusion reactions (HHTR)

Author: Nay Win

It is important to distinguish between HHTR and classical delayed haemolytic transfusion reaction (DHTR) with the latter generally occurring between 2 to 10 days after transfusion with a positive direct antiglobulin test (DAT) associated with identification of new red cell alloantibodies that were not detected pre transfusion. In classical DHTR only transfused cells are destroyed and further transfusion with antigen-negative units is likely to correct the anaemia. Reticulocytosis is a common finding in patients presenting with DHTR. Contrary to this reticulocytopenia is a common finding in HHTR (Petz et al. 1997).

In contrast HHTR appears to be more complex as both the transfused and autologous red cells are destroyed, with post-transfusion Hb levels falling disproportionately and to lower than pre-transfusion levels. Additional transfusion, even with antigen-negative, crossmatch-compatible units may further exacerbate haemolysis with a potentially fatal outcome (Petz et al. 1997).

HHTR has been classified into acute and delayed forms (Win et al. 2008). The acute form usually occurs less than 7 days after receiving the blood transfusion. The DAT is usually negative and no new red cell antibodies are identified in either pre-transfusion or post-transfusion samples and it has been proposed that host factors (activated macrophages) are the main culprit causing red blood cell (RBC) destruction.

The delayed form usually occurs more than 7 days post transfusion. The DAT is positive and new alloantibodies are often identified in the patient's post-transfusion sample. In addition to the activated macrophage mechanism, although difficult to prove, bystander mechanisms might also be involved in destruction of autologous RBC (Petz et al. 2006).

There were 4 HHTR reported to SHOT in 2014: these are described in Chapter 15, Haemolytic Transfusion Reactions.

Key SHOT messages

- HHTR should be suspected if the patient develops severe haemolytic anaemia after transfusion (Post-transfusion Hb levels lower than pre-transfusion value)
- Evidence of haemolysis should be recorded 'Serial measurement of Hb, bilirubin, LDH levels and serial measurements of RBC Hb electrophoresis' (Petz et al. 1997)
- Serial analysis of the urine by high-performance liquid chromatography (HPLC) is useful to document the proportions of HbA and HbS and is a biomarker for red cell destruction (Win et al. 2001)
- Serial measurement of absolute reticulocyte count: a fall in absolute reticulocyte count with recovery manifested by a rise in Hb and reticulocyte count are the common findings in HHTR
- Serial measurement of ferritin: ferritin is a crude marker for macrophages: correlates well with disease activity and clinical response (high during haemolysis and reduced with recovery and a rise in Hb level) (Win et al. 2012, Rogers and Smith 2014). It is useful to monitor the disease activity

- Caution should be taken when a patient with a past history of HHTR needs further transfusion support as HHTR may recur, it appears to be rare but it is not possible to predict when hyperhaemolysis may recur
- In the delayed form of HHTR with or without autoimmune haemolytic anaemia (AIHA), consideration should be given to add additional therapy if no response to standard intravenous immunoglobulin (IVIG)/steroids treatment for example with rituximab (Noizat-Pirenne et al. 2015) or ciclosporin.

Please note that an advisory panel is available for urgent consultation via the National Health Service Blood and Transplant (NHSBT) if clinicians require assistance in management of such cases. Clinicians should contact their red cell immunohaematology (RCI) consultant in normal hours, or the Blood Service consultant on call as soon as possible after HH is suspected. Details will be recorded on a proforma but clinicians should also make their own report to SHOT. These cases should be reported as HTR. The advisory panel includes Nay Win, Paul Telfer, Clare Milkins and Shubha Allard. Clinicans will be asked to report outcome at annual intervals to learn what measures are taken with further transfusions.

References

Fasano RM, Garrett S et al. (2015) **Red blood cell alloimmunization is influenced by recipient inflammatory state at time of transfusion in patients with sickle cell disease**. Br J Haematol 168, 291-300

Noizat-Pirenne et al. (2015) **The use of rituximab to prevent severe delayed haemolytic transfusion reaction in immunized patients with sickle cell disease**. Vox Sang 108 (3), 262–267

Petz L D, et al. (1997) **The sickle cell haemolytic transfusion reaction syndrome**. Transfusion 37, 382-92

Petz L D, et al. (2006) **Bystander immune cytolysis**. Transfus Med Rev 2, 110-40

Rogers M, Smith G. (2014) **Letter to Editor: Hyperhaemolysis in a patient with chronic lymphocytic leukaemia**. Transfus Med 24, 123-124

Vidler JB, Gardner K et al. (2015) **Delayed haemolytic transfusion reaction in adults with sickle cell disease: a 5-year experience**. Br J Haematol doi 10.1111/bjh.13339

Win N et al. (2001) **Hyperhaemolytic transfusion reactions in sickle cell disease**. Transfusion 41, 323-328

Win N et al. (2008) **Hyperhemolysis syndrome in sickle cell disease case report (recurrent episode) and literature review**. Transfusion 48, 1231-1237

Win N et al. (2012) **Measurement of macrophage marker in hyperhaemolytic transfusion reaction: a case report**. Transfus Med 22, 137-141

22 Summary of Incidents Related to Transplant Cases n=46

Authors: Alison Watt and Paula Bolton-Maggs

Since 2012 SHOT has summarised transfusion-related problems in transplant cases and has highlighted particular issues related to transplants that are ABO-incompatible or mismatched for the D antigen. In addition, errors are made related to the specific needs of transplant patients, such as requirements for irradiated blood or specific red cell or human leucocyte antigen (HLA)-matched components.

Key SHOT messages

- ABO-mismatched haemopoietic stem cell transplants (HSCT) and ABO-incompatible (ABOi) solid organ transplants result in complex transfusion-related needs, which can lead to errors
- D-mismatched HSCT can cause problems with component selection. D-mismatched solid organ transplants pose risks to females of childbearing potential if anti-D immunoglobulin (Ig) prophylaxis is not given
- Although there is a section for HSCT in the compatibility transfusion guidelines (BCSH, Milkins et al. 2013), there appears to be a lack of guidance with respect to some important aspects of transfusion management in ABOi and D-mismatched solid organ transplants
- Poor communication and lack of knowledge are the main root causes of errors related to transfusion in complex transplant cases
- Guidelines are needed to cover the specific transfusion requirements for recipients of ABOi solid organ transplants. These should include guidance for transfusion of all blood components, with particular reference to minimising the risk of complications from passenger lymphocyte syndrome (PLS) and risks associated with large plasma volume components (fresh frozen plasma (FFP) and platelets) until ABOi organs become accommodated

Table 22.1: Summary of errors made in transplant cases n=46

Type of transplant	ABO/D errors	SRNM*	Other**	Total
HSCT	18	16	2	**36**
Solid organ	2	6	2	**10**
Total	**20**	**22**	**4**	**46**

**SRNM = specific requirements not met*

***Other = 2 cases of delay due to the incorrect component specification ordered or received from the Blood Service, 1 case transfused when iron had been prescribed to reduce the risk of sensitisation pre-transplant, 1 case plasma exchanged due to erroneous report of high ABO antibody titre*

ABO and D errors n=20

Table 22.2: ABO and D errors in transplant cases n=20

SHOT category	ABO error	D error	Total
Incorrect blood component transfused (IBCT)	11	4	**15**
Near miss	3	2	**5**
Total	**14**	**6**	**20**

ABO/D non-identical	Component	Gender	Transplant type	Patient group	Donor group	Group transfused	Outcome
Incorrect blood component transfused (IBCT) as a result of clinical error							
ABO	Red cells and platelets	Female	HSCT	A	B	A	No adverse reaction
ABO	Red cells	Male	HSCT	A	B	A	No adverse reaction
ABO	Red cells and platelets	Female	HSCT	A	O	A	No adverse reaction
ABO	Red cells	Male	HSCT	A	O	A	No adverse reaction
ABO (Case 1)	FFP	Male	Renal	A	B	A	No adverse reaction
ABO	Platelets	Female	HSCT	A	O	A	No adverse reaction
ABO	Red cells	Male	HSCT	A	?	A	No adverse reaction
D	Platelets	Male	HSCT	D-positive	D-negative	D-positive	No adverse reaction
Incorrect blood component transfused (IBCT) as a result of laboratory error							
ABO	Red cells	Female	HSCT	A	O	A	No adverse reaction
ABO	Red cells	Male	HSCT	B	O	B	No adverse reaction
ABO	Red cells	Male	HSCT	A	O	A	No adverse reaction
ABO	Red cells	Female	HSCT	A	O	A	No adverse reaction
D (Case 2)	Platelets	Male	*Renal	D-negative	?	D-positive	Given anti-D Ig prophylaxis
D	Red cells	Male	HSCT	D-positive	D-negative	D-positive	No adverse reaction
D	Red cells	Female	HSCT	D-positive	D-negative	D-positive	No adverse reaction
Near misses – no components transfused. Intended components and groups listed where known							
ABO	?	Female	HSCT	?	?	?	Near miss
ABO & D (Case 3)	Red cells	Female	HSCT (failed**)	A	AB D-positive	AB D-positive	Near miss
ABO	?	Male	HSCT	?	?	?	Near miss
D	Platelets	Female	HSCT	D-positive	D-negative	D-positive	Near miss
D	Platelets	Female	HSCT	D-positive	D-negative	D-positive	Near miss

Table 22.3: Summary of transplant-related ABO/D non-identical transfusions or near misses n=20

**Error made before ABO and D incompatible solid organ transplant (Case 2)*

***Patient's transplant failed, so had reverted to own group (A) but donor group (AB) red cells were issued (Case 3)*

Case 1: Confusion about appropriate FFP group for ABOi transplant

FFP of the patient's own group (A) was issued to a recipient of an ABOi kidney (group B) two weeks after the transplant. Two units of group A FFP were transfused, but then ward staff queried whether the patient should have been receiving AB FFP instead of group A. No protocol had been provided for this patient to the transfusion laboratory, which is why group-specific FFP had originally been issued, but two group AB FFP units were then issued to complete the transfusion.

There are no national guidelines about transfusion of plasma following ABOi solid organ transplantation and after internal investigation of Case 1, the transplant coordinator concluded there was no issue with the patient receiving blood group A FFP as 'the patient had a low level Anti B titre'. However, there may be insufficient evidence to support this conclusion and it seems likely that it would not be beneficial to transfuse large volumes of plasma that contains antibodies to the donated organ in the early weeks

post transplantation. Further guidance is needed from transplantation experts about the use of large plasma volume components (FFP) and platelets, until it is clear that accommodation of the ABOi organ has occurred. Accommodation is the phenomenon by which an ABOi organ can survive, despite the presence of antibodies in the recipient directed against antigens on that organ. The precise mechanism for accommodation is not known, though several theories have been postulated (Koch et al. 2004). Accommodation usually happens one to two weeks after transplantation and this is defined as the critical period for antibody-mediated rejection (Takahashi 2007). Case 1 occurred 14 days after transplantation, so was still within the critical period.

In the absence of national guidelines most transplant centres will devise their own protocols (Aujayeb et al. 2014). These will often recommend AB FFP to be given in cases such as that described in Case 1 and the selection criteria are usually in place for three months, which is not specifically related to accommodation, but is the recommended time frame when PLS may be a risk factor.

Case 2: Pre-transplant patient given platelets of incorrect D type

A group O D-negative patient was being prepared for an ABOi renal transplant and was due to receive a group B kidney. The patient received 2 pools of platelets which were B D-positive prior to renal transplant. Platelet support prior to transplant should have been group B D-negative. The documented compatibility table available in the laboratory clearly stated that B D-negative platelets were appropriate for this patient, but the biomedical scientist (BMS) only consulted the laboratory information management system (LIMS). An investigation of the LIMS comment showed that it referred only to the ABO group, not the D-negative requirement, which led to the mistaken selection of D-positive platelets. The patient was given prophylactic anti-D immunoglobulin to prevent anti-D sensitisation.

Case 3: Near miss transfusion of ABOi red cells

A request was received for two units of red blood cells for a patient following HSCT. The shared care document received from the transplant centre stated that AB D-positive red cells should be given, but when ward staff collected the unit they informed laboratory staff that the patient was having chemotherapy. Further information was requested and this revealed the patient's HSCT was failing, so the patient's original group, A D-negative, was required. No incorrect units were transfused, but a lack of communication to update the shared care protocol had led to a near miss.

Learning point

The ABO and D requirements when transfusing HSCT recipients can be further complicated if the transplant fails and the recipient must receive components compatible with their original group

Cases 1, 2 and 3 show how complex it can be when patients receive ABOi or mismatched transplants, whether solid organ or HSCT and this can be compounded when HSCT fails and the patient reverts to their own original group, not the donor type. Flags on the LIMS cannot always fully control such complex patient requirements, especially when critical information is time-limited, e.g. actions needed to reduce the risk of PLS for three months after an ABOi solid organ transplantation. The most serious errors relate to ABO or D, because these can lead to actual or potential incidents of incorrect blood component transfused. In the three years of analysing transplant cases, there has been a total of 47 ABO/D errors, 18 in 2012, 9 in 2013 and 20 in 2014. A full breakdown is shown in Figure 22.1.

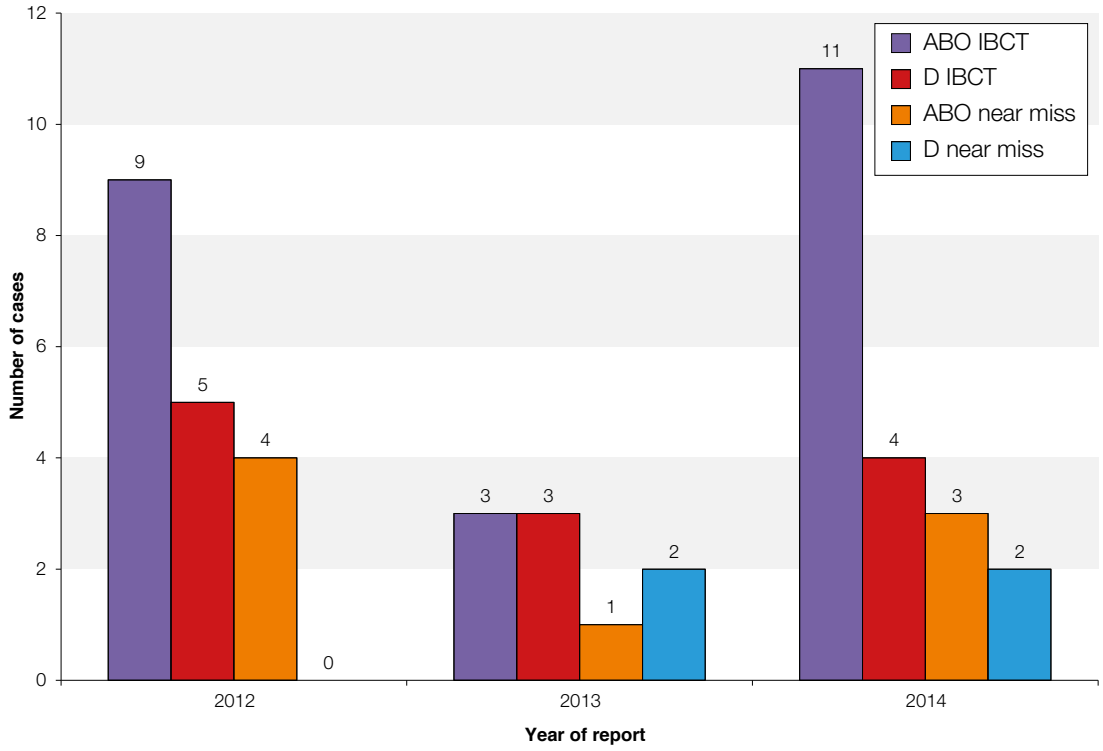


Figure 22.1: Transplant-related ABO and D errors, both IBCT and near miss cases, 2012-2014

Specific requirements not met n=22

SHOT category	Irradiated	CMV negative	Other*	Total
Errors related to solid organ transplants				
SRNM clinical error	1	1	0	**2**
SRNM laboratory error	1	0	2	**3**
Near miss clinical error	0	0	0	**0**
Near miss laboratory error	1	0	0	**1**
Subtotal errors solid organ	**3**	**1**	**2**	**6**
Errors related to HSCT				
SRNM clinical error	9	0	0	**9**
SRNM laboratory error	2	0	0	**2**
Near miss clinical error	4	0	0	**4**
Near miss laboratory error	1	0	0	**1**
Subtotal errors HSCT	**16**	**0**	**0**	**16**
Total	**19**	**1**	**2**	**22**

**Other = 1 case incorrect red cell phenotype and 1 case electronic issue that should have been crossmatched*

Table 22.4: Failure to provide components with specific requirements for transplant patients n=22

In 2014 there were fewer reports of failures to give irradiated blood to solid organ recipients (n=3) compared to 2013 (n=29) although, one centre accounted for 16/29 cases in 2013, due to recipients being treated with Campath-1H® (alemtuzumab) and not receiving irradiated components in line with British Committee for Standards in Haematology (BCSH) guidelines on the use of irradiated blood components (BCSH Treleaven et al. 2011).

Causes of errors

Table 22.5: Causes of all transplant errors, including near misses n=46

Error made	ABO/D error	SRNM	Other	Total
Errors related to solid organ transplants				
Clinical error - protocol or communication	1	2	0	**3**
Clinical decision making	0	0	1	**1**
Laboratory error - LIMS flags not heeded or updated	0	3	0	**3**
Laboratory error - communication	0	1	**0**	**1**
Lack of understanding in laboratory	1	0	1	**2**
Subtotal errors solid organ	**2**	**6**	**2**	**10**
Errors related to HSCT				
Clinical error - protocol or communication	10	13	0	**23**
Laboratory error - LIMS flags not heeded or updated	7	3	1	**11**
Laboratory error - communication	0	0	1	**1**
Lack of understanding in laboratory	1	0	0	**1**
Subtotal errors HSCT	**18**	**16**	**2**	**36**
Total	**20**	**22**	**4**	**46**

Non-error transplant-related cases

Incidents reported to SHOT in transplant patients can highlight other transfusion-related issues, even if they are not caused by errors.

In one case a patient who had received an allogeneic HSCT was Jk(a+) pre transplant, but the donor was Jk(a-). The patient had a haemolytic transfusion reaction, which appears to have been caused by an anti-Jka of donor origin. For further details see Case 2 in Chapter 15 Haemolytic Transfusion Reactions (HTR).

A D-negative patient was transfused with D-positive red cells, which is commonly done in elderly patients in order to conserve supplies of D-negative red cells. However, this patient was due to receive a bone marrow transplant at a different hospital, so it was not advisable in this case to transfuse D-positive cells to a patient who is likely to require long term transfusion support. Further detail is given in Chapter 16 Alloimmunisation.

Conclusion

In both the 2012 Annual SHOT Report (Bolton-Maggs et al. 2013) and 2013 Annual SHOT Report (Bolton-Maggs et al. 2014), recommendations were made that transplant guidelines needed to be developed to cover identified gaps in communication and when transplanting D-positive organs to D-negative female recipients who are of childbearing potential. The need for clear guidelines from the transplant experts is further highlighted by cases reported to SHOT in 2014.

In 2014 another surprising gap in the guidelines has been noted, related to the lack of national transfusion protocols for plasma rich components in the immediate post-transplant period following an ABOi solid organ transplant. This correlates with concerns raised in the 2013 Annual SHOT Report and in a literature review (Nadarajah et al. 2013) about transfusion and risks associated with PLS. Therefore, SHOT is recommending that the transfusion advice in the existing BCSH guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories (BCSH, Milkins et al. 2013) is supplemented by guidance produced by transplantation experts.

References

Aujayeb A, Lordan J, et al. (2014) **The passenger lymphocyte syndrome – experience from a cardiothoracic transplant unit**. Transfus Med 24, 423–425 Supporting information - link for Table S2. Selection of blood and blood products for ABO mismatch transplants - http://onlinelibrary.wiley.com/store/10.1111/tme.12158/asset/supinfo/tme12158-sup-0002-TableS2.doc?v=1&s=63c8887f0985cb7c31462ab2dfd8b4eedb2c6370 [Accessed 12 /03/2015]

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

BCSH Treleaven J, Gennery A et al. (2011) **Guidelines on the use of irradiated blood components, prepared by the British Committee for Standards in Haematology blood transfusion task force**. Br J Haematol 152, 35–51. doi: 10.1111/j.1365-2141.2010.08444
http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2141.2010.08444.x/full [Accessed 12/03/2015]

BCSH (2012) **Addendum to guidelines on the use of irradiated blood components**.
http://www.bcshguidelines.com/documents/BCSH_TTF_addendum_irradiation_guidelines_final_6_11_12.pdf [Accessed 12/03/2015]

Karakantza M, Dukka S et al. (2014) **Use of anti-D immunoglobulin prophylaxis in solid organ transplants**. Transfus Med 24, 421–422 http://onlinelibrary.wiley.com/doi/10.1111/tme.12165/full [Accessed 12/03/2015]

Koch, Cody A, et al. (2004) **Accommodation: preventing injury in transplantation and disease**. J Immunol 172(9), 5143-5148

Takahashi K. (2007) **Recent findings in ABO-incompatible kidney transplantation: classification and therapeutic strategy for acute antibody-mediated rejection due to ABO-blood-group-related antigens during the critical period preceding the establishment of accommodation**. Clin Exp Nephrol 11.2, 128-141

Nadarajah L, Ashman N, et al. (2013) **Literature review of passenger lymphocyte syndrome following renal transplantation and two case reports**. Am J Transplant 13, 1594-1600

Bolton-Maggs PHB, Poles D et al (2013) **2012 Annual SHOT Report** www.shotuk.org

Bolton-Maggs PHB. Poles D et al. (2014) **2013 Annual SHOT Report** www.shotuk.org

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Web Edition: Chapters Relating to Other Error Reports

Chapter **Page**

Chapters Relating to Other Error Reports

23 Right Blood Right Patient (RBRP) n=169

Authors: Alexandra Gray and Hema Mistry

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 being transfused (IBCT).

This category currently includes errors associated with labelling and patient identification (ID), for example:

- Administration with incorrect or incomplete/missing patient details on the label
- Transposition of labels between units that are all intended for the same patient
- Absence of a patient ID wristband
- Transfusion of a blood component that was intended for the patient, but was not formally prescribed/authorised

As in previous years reporters have been given the opportunity to separately submit incidents where the right blood was transfused to the right patient despite a number or errors that may have led to the unit being rejected or an incomplete documentation trail being available for that transfusion episode. These errors do not fit into the definition of IBCT because the blood component was intended for the patient receiving the transfusion, but have been included to inform practice. There were 169 cases analysed in 2014, representing a decrease from 184 cases in 2013.

Key SHOT messages

- Hospitals using electronic blood management systems should review the individual use of 'emergency' procedures used to bypass the built-in checks whether at the bedside or when collecting blood from the refrigerator. There should be immediate retraining of staff using the system incorrectly
- Hospitals should work with the manufacturer to develop safe and robust emergency protocols, which prevent blood delay but still provide full traceability and effective bedside 'right blood right patient' checks

Table 23.1: RBRP episodes n=169

	2013	2014
Patient identification errors	**118**	**116**
Name alone or with other elements	*51*	*45*
Date of birth (DOB) alone or with other elements	*28*	*32*
Wristband* missing/wrong wristband in place at final bedside checking procedure	*14*	*11*
Hospital or National Health Service (NHS) number	*21*	*27*
Address alone or with other elements	*3*	*1*
Patient ID details missing on sample tube/request form	*1*	*0*
Labelling errors	**52**	**34**
Transposed labels	*38*	*24*
Other labelling errors	*14*	*10*
Miscellaneous errors (Category: 15 documentation; 4 misc)	**14**	**19**
Prescription error	*9*	*14*
No final patient ID check undertaken prior to administration of component	*1*	*2***
Issue procedures errors	*2*	*2*
False identity	*2*	***
Wrong component selected	*0*	*1*
Total	**184**	**169**

**'Wristband' refers to identification wristband (or risk assessed equivalent) as defined in the British Committee for Standards in Haematology (BCSH) Guideline on the Administration of Blood Components (2010)*

***273 components were issued from a BloodTrack refrigerator with no 'right blood right patient' check undertaken – users when removing components from the refrigerator used the system designed to issue O D-negative blood in an emergency*

**** moved to unclassifiable complications of transfusion (UCT) category and are described in Chapter 8 Human Factors*

Case 1: Duplicate records merged on the hospital computer system causing the patient's hospital number to change

A baby admitted to the special care baby unit (SCBU) was registered with two hospital numbers (HN1 and HN2); the first sample received by the laboratory was consistent with the baby's wristband and case notes (HN1) and matched all blood components transfused following admission. When fresh frozen plasma (FFP) was requested 2 days later the biomedical scientist (BMS) noted the results in the information technology (IT) system were recorded using a different hospital number (HN2); they informed the staff that blood components would be issued using the first hospital number (HN1) and this must match the baby's wristband. A note was left asking the transfusion practitioner to investigate. Three days later the BMS on-call noticed all samples were displaying the second hospital number (HN2). Following discussion with the ward staff it was confirmed the number on the baby's wristband had been changed to the second hospital number (HN2) on the day following admission. A comment was attached to sample in the laboratory IT system and the ward staff were informed a further sample would be needed if more blood components were required. On investigation it was found that all components issued after the wristband had been changed had a different number (HN2) to the hospital number on the component (HN1); the error was not picked up during the final bedside check. The investigation team was advised that the maternity ward staff often did not have time to admit the baby prior to transfer; they created a duplicate patient record in order to expedite the SCBU admission thereby creating a duplicate hospital number as the ward also created a new record. The admission process has been revised in light of the error.

Near miss RBRP cases n=118

Similar lessons can be learned from near miss incidents relating to cases that would have led to a right blood right patient transfusion if not detected in time.

Table 23.2: Near misses that could have led to RBRP n=118

Point in the process	Type of error made	Number of cases	Percentage of cases
Sample receipt	Sample labelling error not rejected	19	28.0%
	Wrong identifiers entered in the laboratory information management system (LIMS)	14	
Component labelling	Transposition labels for same patient	64	72.0%
	Incorrect patient information on label	21	
Total		**118**	**100%**

IT-related RBRP cases n=57

Failure to consult historical record or link two records n=15

If there are incorrect details on the request form or sample, the historical computer record on the LIMS may not be accessible and this led to a situation where blood was transfused with incorrect demographic details in 12 cases.

In three infants, two of whom were under one month old, there were two computer records containing different hospital numbers in two, and a different surname in the third. These records were not merged or linked so there was an incomplete transfusion record and the fresh frozen plasma (FFP), red cells and red cells plus platelets when issued did not match the wristband at the bedside.

Discrepancy between LIMS and patient administration system (PAS) n=8

In five cases blood should not have been given because there was a discrepancy in demographic details between LIMS and PAS. This resulted in one or more core identifiers being different between the compatibility tag (printed from the LIMS) and the wristband (printed or hand-written from the PAS information). In another case, blood was issued against the ID which did not match the wristband because the patient had been transferred in from another hospital.

Incorrect result or data entered or accessed manually n=27

At some stage in each of these cases an incorrect name or date of birth was entered either onto the PAS or LIMS.

Case 2: Unfamiliarity with new computer system results in manual transcription error

The hospital introduced a new computer system and nursing staff were unable to use it to request pathology tests. A list of ward patients was printed off from the computer and this was used to complete a paper request for transfusion and chemistry tests. The wrong DOB was selected from the patient list (it was the DOB for the next patient on the list) but the chemistry BMS changed it to the correct DOB on the LIMS. When the blood was administered there was an incorrect DOB on the prescription and wristband and a correct but discrepant DOB on the compatibility label.

IT systems and equipment failure n=6

Printer errors n=4

- The addressograph label on a blood request form had been misprinted over two sticky labels and was pieced together omitting a digit in the ID number. The hospital number was incorrect at the bedside check. A traceability label was returned and had no patient ID or name on it because it had been printed incorrectly. It was not clear if this was the whole label or just the tear-off portion but the blood could not have been properly checked when the blood was issued, collected or administered
- Two unknown patients were being treated in the emergency department (ED) at the same time and multiple blood components were transfused to a patient identified as ‘unknown 2’ but the wristband printer could not print numbers next to text and so the compatibility tag did not match the ID wristband

- In another case an error in the patient ID was noted on PAS but staff were not able to correct this or reprint a correct wristband

Computer downtime n=2

- An incorrect expiry was written on a compatibility tag when issuing solvent detergent (SD)-FFP manually because the LIMS was down and a manual back up system was being used
- A previously transfused patient received emergency blood and then further group O blood from the transfusion department but, because the LIMS was down, the unit was issued without a label because there was no back up system in place

Incorrect use of a bedside blood tracking system (273 units and 105 members of staff)

One hospital reported multiple failures of the 'right blood right patient' bedside check related to the incorrect use of a bedside tracking system and below is the report provided which explains the nature of the error.

Case 3: Incorrect use of a bedside blood tracking system (273 units)

A cause for concern – the hospital report January 2015 (included with permission from both the hospital and Haemonetics)

We have been using the BloodTrack SafeTx electronic system from Haemonetics for the past 5 years and we transfuse in the region of 35,000 units per annum. Using this system we have a traceability figure of 99.7% as opposed to 86% using a manual paper-based system.

A third of these transfusions are carried out using the EMERGENCY TRANSFUSION option, most of which are carried out in theatres and the emergency department (ED). The decision to use this option was made by these clinical areas primarily to avoid the need to record observations at each stage of the process, thus speeding up the procedure. Consideration has been given to removing the 'observations' option from the devices used in these specific areas but this would have caused problems when devices are swapped between different clinical areas.

When the emergency option is chosen, after scanning the patient's identification band, the user encounters the following screen:

At this juncture the screen asks the user to either
(a) scan the compatibility label which is attached to the units or
(b) '**Or Tap Here To Give Emergency Blood**' if using the **emergency O Rh D-negative blood** which of course does not have a compatibility label. When this second option is chosen, the built in 'right blood right patient' safety checks are quite correctly bypassed by the system.

From February 2014 we have been auditing every single unit which has been transfused using the EMERGENCY TRANSFUSION option and these are the results.

Between February and October 2014 a total of 273 units (average of 30 units/month) were transfused using the wrong option whereby the 'right blood right patients' safety checks were bypassed in error. The user had not scanned the compatibility label as they should have, but instead had chosen the '**Or Tap Here To Give Emergency Blood**' option even though they were not using the emergency O D-negative. A total of 105 staff were involved.

An incident report was raised on each occasion and the member of staff involved was contacted by e-mail. A one-to-one re-training session was conducted, where the potential gravity of their error was reinforced. There were no repeat offenders identified. The message is beginning to get through, since the numbers for November and December 2014 are encouraging. Only 2 units were transfused using the incorrect option in November, and 13 units in December. This error occurs both when only one or two units are given and when multiple units are given i.e. major haemorrhage.

The company (Haemonetics) have acknowledged this potential weak link in an otherwise very safe system, and have made assurances that it will be rectified in the next software version due in June 2015. In the meantime we intend to continue with our present policy of raising an incident report and conducting one-to-ones with the individuals concerned, every time it happens.

Electronic blood tracking systems are designed to reduce human error at the bedside. However, all staff must be trained to use the system safely and in the manner for which it was intended. The Emergency Blood option was intended for emergency group O units that did not have a compatibility label attached to them but in this situation it was used to avoid having to enter observations because they were being recorded elsewhere.

As noted above the company has responded to this incident (and an additional report). They note that 'the Emergency Transfusion protocol is meant to be faster and only meant to be used for emergency situations. It removes completion of configuration checklists and removes entering of vital signs. By using the '**or tap here to give emergency blood**' button the user is telling BloodTrack Tx that there is no compatibility label to scan and that the unit is an uncrossmatched unit. Use of this process for non-emergency transfusions is misuse resulting in bypassing the important safety step of checking that the unit is actually intended for the patient. The company have taken the following actions:

- Root cause analysis of the incident above
- Review other sites to determine whether this issue is occurring elsewhere
- Sent an advisory letter to all customers reminding them of correct use and confirmation of the next release of software which will include enhancements to the Emergency Blood protocol

COMMENTARY

As in previous years the RBRP root cause analyses continue to identify key practices that cause the primary error; including transcription errors at admission and sample registration, patient ID errors at sampling, component labelling errors, failure to check the component at issue, collection and/or receipt in the clinical area and during pre-administration checks of both the component and the associated documents. The final opportunity to recognise the error is then missed at the patient identity check prior to the start of transfusion. This year we saw how staff were able to circumvent an IT management solution in order to collect units from the blood refrigerator without entering any patient ID.

Learning point

- All staff using electronic inventory or bedside transfusion management solutions must be trained in their use and be able to demonstrate competence (BCSH Jones et al. 2014). Regular audits should be undertaken to ensure compliance

References

BCSH Harris AM, Atterbury CL, et al. (2009) **Guidelines on the administration of blood components**. http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf [Accessed 30/03/2015]

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.bcshguidelines.com/4_haematology_guidelines.html?dtype=Transfusion&dpage=0&sspage=0&ipage=0#gl [Accessed 30/03/2015]

24 Handling and Storage Errors (HSE) n=188

Authors: Alexandra Gray and Hema Mistry

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.

The number of reports submitted under the HSE category in 2014 (188 reports) is similar to 2013 (193 reports). There was however an increase in the number of technical errors reported, and a decrease in the number of excessive time to transfuse reports compared to 2013. There were no transfusion-related deaths or instances of serious patient harm reported in relation to these incidents.

In addition there have been 98 cases of near miss incidents associated with handling and storage errors, but fortunately these were picked up before the transfusion started, Table 24.5.

Technical administration errors n=42 (20 in 2013)

In 18/42 cases (42.9%) the report resulted from the use of the wrong type of giving set. In 5 cases the patients were overtransfused and 1 patient undertransfused due to errors when setting up an infusion pump, including 5 paediatric patients. Three patients (including 2 paediatric patients) received red cells more rapidly than prescribed. In 2 cases the patient received a transfusion despite the component pack being damaged.

Transfusion of expired blood components n=30 (23 in 2013)

Fifteen errors originated in the clinical environment; again this year errors result from components being issued with a short expiry date and/or the component still being available for collection close to or after the expiry date; on at least 2 occasions the person collecting the component ignored the electronic refrigerator warning.

All errors that originated in the laboratory are discussed in Chapter 11 Summary of Events Originating in the Hospital Transfusion Laboratory and further cases of component expiry are also discussed in Chapter 6 Medicines and Healthcare products Regulatory Agency (MHRA) Report on Blood Safety and Quality Regulation in 2014.

Excessive time to transfuse n=37 (83 in 2013)

In 23/37 cases (62.2%) the transfusion took more than 6 hours (range 6 to >21 hours). In 20/37 cases (54.1%) the error resulted from a delay in commencing the transfusion; 19/33 events where the time was known (57.6%) took place during core hours (Table 24.1). The recommended times for transfusing blood components are available in current guidelines (BCSH Harris et al. 2009).

Table 24.1: Breakdown of time of transfusions that took excessive time to run

Time period	In core hours / out of core hours	Number
08:00 to 20:00	Core hours	19
20:00 to 00:00	Out of core hours	8
00:00 to 08:00	Out of core hours	6
Unknown		4
Total		**37**

Learning point

- Blood warmers – users must be familiar with the manufacturer's instructions and should be deemed competent as part of the transfusion process, particularly in the paediatric setting

Cold chain errors n=79 (67 in 2013)

Type of error	Number of cases 2013	Number of cases 2014
Equipment failure (power failure/suspected refrigerator failure which failed to activate the alarm)	11	6
Alarm-related (staff failed to carry out correct procedure following alarm being triggered on a refrigerator)	3	6
Transport or delivery of components	7	3
Inappropriate storage of components (Tables 24.3 & 24.4)	46	64
Total	**67**	**79**

Table 24.2: Cold chain errors n=79

The main increase of reports resulted from inappropriate storage of components where 64 cases were reported in 2014 compared to 46 in 2013; these are discussed further below, in Tables 24.3 and 24.4.

Inappropriate storage of components n=64

In 37/64 (57.8%) cases inappropriate storage errors occurred in a laboratory setting and 27/64 (42.2%) in the clinical area, Tables 24.3 and 24.4.

Type of inappropriate laboratory storage error	Number of reports
Returned to stock when they should have been discarded	10
Stored inappropriately in laboratory area	3
Incomplete cold chain	2
Units transfused in which interval between sampling and transfusion had exceeded BCSH guidelines:	
Failure to clear the refrigerator	9
Where sample was invalid*	13
Total	**37**

**Invalid sample, where sample was taken >72 hours prior to testing, and a new sample should have been requested*

Table 24.3: Breakdown of laboratory causes of inappropriate storage of components n=37

Type of inappropriate clinical storage error	Number of reports
Returned to stock when they should have been discarded	8
Incomplete cold chain	5
Stored inappropriately in clinical area	14
Total	**27**

Table 24.4: Breakdown of clinical causes of inappropriate storage of components n=27

There were 14 instances where blood components were stored inappropriately in clinical areas (7 red cells, 6 platelets, 1 fresh frozen plasma).

Near miss HSE cases n=98

The near miss incidents relating to handling and storage errors show similar learning points to the full incidents which led to a transfusion of components handled or stored incorrectly.

Table 24.5: Near misses that could have led to HSE n=98

Point in the process	Type of error made	Number of cases	Percentage of cases
Component selection	Expired unit	11	11.2%
Collection	Time expired component available	33	33.7%
Administration	Incorrect transport/packing of units	10	34.7%
	Inappropriate storage in clinical area	17	
	>30 minutes out of temperature control in clinical area	6	
	Unit expired on ward	1	
Other	Outside sample suitability	7	20.4%
	Incorrect storage in the laboratory	11	
	Part used unit returned to refrigerator	1	
	Bacterial contamination of unit	1	
Total		**98**	**100%**

IT-related HSE cases n=17

Blood issued against an invalid sample n=2

In two cases the sample from a previously transfused patient was older than 72 hours. In the first case there was failure to consult the transfusion history and on the other occasion there was no flag or alert in place to support decision-making. On both occasions blood was issued and transfused in error.

Incorrect use of the electronic blood management system n=12

Red cells were transfused when they should have been discarded because electronic blood management systems associated with blood refrigerators were not used as intended.

Clinical staff did not heed alarms that indicated that units of blood should not be used because they were out of temperature control in four cases or had expired in two cases, although no harm came to the patients who were transfused this blood.

Laboratory staff also contributed to errors. On two occasions the laboratory gave incorrect advice in response to an alarm indicating that the blood was unsuitable for transfusion due to being out of temperature control. In a further case the alarm that indicated the sample or the blood had expired was not heeded. Lack of response to the alarms was attributed to being too busy in two cases.

In another case poor synchronization of the clocks on the BloodTrack kiosks led to blood being issued that should have been flagged as out of temperature control.

Other equipment errors n=3

Two laboratories did not follow their own procedures when handling blood refrigerators and this led to blood being transfused that was out of temperature control. In one case the blood refrigerator was serviced but not correctly returned to use and in another a number of red cell units were out of temperature control because of a refrigerator failure but the units were not removed from the supply chain. One of the units was subsequently transfused.

The third case was an error related to the settings on an infusion pump. As a result blood was given too fast.

COMMENTARY

This year the main learning points and errors that have occurred are the same as those reported in the HSE chapter in the 2013 Annual SHOT Report (Bolton-Maggs et al. 2014). Further information on how to prevent such errors can be found in the following:

British Committee for Standards in Haematology (BCSH) – Administration guidelines: (BCSH Harris et al. 2009))

- A robust procedure needs to be in place with effective communication between the clinical and laboratory staff to avoid units being placed back into stock when they should be discarded, especially if they have been out for more than 30 minutes
- The correct storage conditions of all blood components

BCSH – Pre-transfusion guidelines (BCSH Milkins et al. 2012):

- Laboratory staff also need to be more vigilant when issuing units to ensure that pretransfusion checks have been performed with a valid sample.

Blood Safety and Quality Regulations 2005 (BSQR 2005)

- The importance of the 'cold chain' and how it must be maintained, and the relevant storage of 'cold chain' documentation must be available
- Differences between cold chain and traceability

Learning points remain pertinent from 2011 – 2013.

NOTE: The numbers in the SHOT HSE chapter may not reconcile with those in the MHRA chapter. This is because there is a difference in reporting definitions between the 2 organisations, and SHOT also includes a clinical aspect. However both SHOT and MHRA are in process of producing a unified haemovigilance system.

References

BCSH Harris AM, Atterbury CLJ et al. (2009) **Guideline on the administration of blood components**. http://www.bcshguidelines.com/documents/Admin_blood_components_bcsh_05012010.pdf

BCSH Milkins C, Berryman J et al. (2012) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. Transfus Med 23(1), 3-35

BSQR (2005) **Blood Safety and Quality (Amendment) (No.2) Regulations 2005 No. 2898**. http://www.legislation.gov.uk/uksi/2005/2898/contents/made [Accessed 30/03/2015]

Bolton-Maggs PHB, Poles D et al. (2014) **The 2013 Annual SHOT Report**. www.shotuk.org [Accessed 30/03/2015]

25 Anti-D Immunoglobulin (Ig) Incidents n=359

Author: Tony Davies

Definition:

An adverse event relating to anti-D Ig is defined as relating 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.

A total of 389 case reports involving anti-D Ig were submitted via the SHOT online reporting database in 2014. Of these 30 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.

359 case reports, each involving 1 individual, were considered in the final analysis.

The reports are broken down into the reporting categories shown in Table 25.1.

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.

From January 2013 SHOT has been conducting a study to look at women who have produced immune anti-D that is detectable for the first time in the current pregnancy and an analysis of the data collected to the end of December 2014 is included in Chapter 13 Anti-D Immunoglobulin – Prescription, Administration and Sensitisation.

Key SHOT messages

- It does not matter whether staff follow British Committee for Standards in Haematology (BCSH), National Institute for Health and Care Excellence (NICE) or a combination, as long as the Trust/ Health Board has a robust, consistent policy agreed by all stakeholders. Adoption of the SHOT anti-D flowchart has been recommended by the British Committee for Standards in Haematology (BCSH) and the Royal College of Obstetricians and Gynaecologists (RCOG)
- Anti-D Ig must be made readily available for administration to women when they present with potentially sensitising events, rather than putting the onus on them to return for the injection at a later date

Table 25.1: Reporting categories

Category of adverse event	Number of cases	
Omission or late administration of anti-D Ig	273	
Inappropriate administration of anti-D Ig - Total	66	
to a D-positive woman		*24*
to a woman with immune anti-D		*16*
erroneously to a mother of a D-negative infant		*14*
given to the wrong woman		*12*
Wrong dose of anti-D Ig given according to local policy	16	
Handling and storage errors relating to anti-D Ig	4	
Total	**359**	

Deaths n=0

There were no reported fetal deaths following the omission or delay in administration of anti-D Ig.

Major morbidity n=4

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

In one case immune anti-D was wrongly assumed to be prophylactic and so the pregnancy continued unmonitored, resulting in a severe case of haemolytic disease of the fetus and newborn (HDFN) requiring intensive transfusion support.

Potential for major morbidity n=270

In a further 270 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 these events resulted in the production of immune anti-D.

Clinical versus laboratory errors

For the reporting year 2014, 359 events relating to anti-D Ig administration are summarised in Table 25.2 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	273	239	21	13
Anti-D Ig given to D-positive woman	24	18	5	1
Anti-D Ig given to woman with immune anti-D	16	7	7	2
Anti-D Ig given to mother of D-negative infant	14	0	14	0
Anti-D Ig given to wrong woman	12	11	1	0
Wrong dose of anti-D Ig given	16	7	8	1
Anti-D Ig handling & storage errors	4	3	1	0
Total	**359**	**285**	**57**	**17**

Table 25.2: Staff groups primarily involved in anti-D Ig process failures

This year maintains the pattern of reports described in 2013 with clinical cases involving midwives, nurses and doctors accounting for 302/359 (84.1%) while laboratory cases are reduced accounting for 57/359 (15.9%) of the total reports relating to prescription, requesting and administration of anti-D Ig.

Omission or late administration of anti-D Ig n=273

In 239/273 (87.5%) cases the primary error was made by a nurse or midwife, and in 13/273 (4.8%) cases by a doctor. Twenty of 273 (7.3%) cases resulted from failures in the hospital laboratory and 1/273 cases from a Blood Service reference laboratory. The location was in the community for 54 cases, and in a hospital setting for 219:

- 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 86/273 (31.5%) cases of delayed or omitted anti-D Ig
- In 48 cases it was ‘noted at delivery’ that a woman had not received routine antenatal anti-D prophylaxis (RAADP)

- There were 7 cases where midwifery staff had transcribed the blood group incorrectly as D-positive into the antenatal notes
- There were 6 cases where the laboratory erroneously entered a grouping result (1 maternal, 5 cord) manually to the laboratory information management system (LIMS)
- There were 4 cases where the laboratory supplied D-positive platelets to D-negative women (and children) of childbearing potential without offering prophylactic anti-D Ig
- There were 10 cases where RAADP was not given because the clinical staff erroneously thought that anti-D Ig recently given for a sensitising event would be sufficient
- All 13 cases involving medical staff (including trainees, consultant obstetricians, general practitioners (GPs) and consultant haematologists) involved poor decision-making about the need for anti-D Ig which was clearly not in line with national guidance
    - One obstetrician refused to prescribe anti-D Ig for sensitising events in the third trimester because the woman had received RAADP at 28 weeks of gestation
    - One obstetrician informed a woman that she wouldn't need any anti-D Ig for sensitising events until she had passed 20 weeks of gestation

Case 1: Post-natal visits fail to pick up need for anti-D Ig

A woman was discharged on day 0, and despite home visits by the community midwife team on days 2,3 and 4, the need for anti-D Ig was not noted until post-natal day 6.

Case 2: Anti-D Ig is needed for D-positive platelets

A 2 year old girl (D-negative) with leukaemia was issued with D-positive human leucocyte antigen (HLA)-matched platelets, but the laboratory neglected to offer prophylactic anti-D Ig.

Case 3: Discharge paperwork completed inaccurately

Anti-D Ig was issued for a post-natal woman, but not collected although the laboratory telephoned the ward three times to tell them it was ready. The woman was discharged with a note on her file saying anti-D Ig was not required.

Case 4: Laboratory reports must be clear

The laboratory issued a report following an antepartum bleed at 30 weeks indicating a transplacental haemorrhage of <2mL fetal red cells by Kleihauer, which the obstetric registrar interpreted as meaning no need for anti-D Ig as the woman had received RAADP at 28 weeks.

Case 5: Do not put the onus on the woman to comply with the system

A woman attended the antenatal unit after suffering a vaginal bleed, but was told to return the next day as the unit closed early on a Friday afternoon. At the time the report was submitted to SHOT (14 days later) she had not returned.

Inappropriate administration of anti-D Ig n=66

This group is further subdivided into four categories.

Anti-D Ig given to D-positive women n=24

Overall 18/24 (75.0%) errors were made by a nurse or midwife, 1/24 (4.2%) by a doctor, and 5/24 (20.8%) primary errors arose in the laboratory.

20/24 (83.3%) cases originated in the hospital setting, with 4 (16.7%) in the community.

Case 6: Medical laboratory assistant (MLA) overlooks D-positive result on computer

Anti-D Ig was requested following a surgical termination of pregnancy. The MLA issuing the anti-D overlooked the blood grouping result on the laboratory computer, which clearly showed the woman to be D-positive and issued the anti-D Ig to the clinical area.

Case 7: Laboratory report misinterpreted

Anti-D Ig was issued from clinical stock for a post-natal woman, after staff misinterpreted 'Antibody Screen Negative' as 'D-negative'. The ward procedure has been changed to ensure a check of grouping results by two people before treatment decisions are taken.

Case 8: Transcription of blood groups is dangerous

Anti-D Ig was administered in a private clinic by a consultant, following the incorrect manual entering of the woman's blood group by a clerk onto the clinic computer. The consultant has insisted on sight of validated laboratory reports prior to issuing anti-D Ig in the future.

Anti-D Ig given to women with immune anti-D n=16

- 9/16 (56.3%) resulted from a primary clinical error
- 7/16 (43.7%) resulted from a laboratory error

All 16 cases occurred in the hospital setting.

- Five of these cases involved issue of anti-D Ig from stocks held in the clinical area to women known to have immune anti-D
- Another five of these cases involved issue of anti-D Ig to women who were clearly marked on the laboratory system as having immune anti-D

Case 9: Assumption leads to unmonitored pregnancy and HDFN

A biomedical scientist (BMS) assumed that a positive antenatal antibody screen was due to prophylactic anti-D (the woman had received none at all), resulting in the pregnancy progressing unmonitored beyond basic antenatal appointments. The woman had anti-D levels of 67.0IU/mL at term, and her child was born suffering severe HDFN requiring exchange and top-up transfusions.

Case 10: Poor advice from haematologist

A pregnant woman identified as having immune anti-D (9 years previously) was referred to a consultant haematologist because of essential thrombocythaemia. During the appointment, she asked advice on anti-D Ig prophylaxis, and was told that she needed routine prophylaxis at 28 weeks.

Anti-D Ig given erroneously to mothers of D-negative infants n=14

All 14 of these errors originated in the laboratory, and all 14 occurred in the hospital setting.

- 3/14 cases involved issue of anti-D Ig before testing the cord group
- 5/14 involved the cord blood group being manually entered (incorrectly) onto the LIMS
- 5/14 involved issue of anti-D Ig without reference to LIMS results
- 1/14 involved assumption that a maternal sample was related to a potentially sensitising event (PSE) rather than post-natal

Case 11: Laboratory assumption regarding maternal sample

Mother and cord samples were sent to the laboratory, but the maternal sample was rejected due to incomplete labelling. The cord sample was tested as D-negative. A repeat maternal sample arrived, which the duty BMS assumed was related to a PSE in late pregnancy, and proceeded to issue 500IU anti-D Ig.

Anti-D Ig given to the wrong woman n=12

- 11/12 cases were clinical errors, involving failure by nurses and midwives to carry out positive patient identification. Nine cases occurred in the hospital setting, with 3 in the community
- 1/12 cases was a laboratory error, involving selection of the wrong woman from the laboratory computer system in order to print labels (both women were present at the same time on the post-natal ward)

Case 12: Checking and administration must be a continuous process

Anti-D Ig was issued by the laboratory for a post-natal woman. The anti-D Ig was checked by two qualified midwives, but then placed in the drug refrigerator as the woman was asleep. A midwife on the next shift then administered the anti-D Ig to the wrong woman without performing positive patient ID checks.

Wrong dose of anti-D Ig given n=16

Thirteen of these 16 cases occurred in hospital, and 3 in the community setting.

Eight cases involved a primary clinical error, with 8 errors in the laboratory.

Case 13: Communication failure leads to incorrect dosing

The laboratory informed the midwife that the woman should receive 500IU anti-D Ig, but the midwife administered a 250IU dose from stock held in the clinical area.

Case 14: Doctor administers inadequate dose of anti-D Ig

An obstetric registrar prescribed 500IU anti-D Ig from clinical stock for a woman due to receive 1500IU RAADP at 28 weeks of gestation.

Case 15: Misinterpretation of Kleihauer film leads to over-dosing with anti-D Ig

A BMS interpreted a Kleihauer film as showing a raised transplacental haemorrhage (TPH) of 25mL fetal red cells, and issued 3000IU anti-D Ig to cover the bleed. Flow cytometry showed the TPH to be <1mL and later examination of the Kleihauer film by a senior member of staff gave a result consistent with the flow cytometry estimation.

Case 16: Misinterpretation of Kleihauer film leads to under-dosing with anti-D Ig

A BMS interpreted a Kleihauer film as showing a raised TPH of 3.3mL fetal red cells, and issued 500IU anti-D Ig to cover the bleed. Flow cytometry showed the TPH to be 8.4mL, requiring double the original dose. The extra was administered 4 days later as the woman had been discharged after receiving the first injection. Examination of the Kleihauer film by a senior member of the laboratory staff indicated a TPH consistent with the flow cytometry estimation.

Comment: Cases 15 and 16 are included to underline that the Kleihauer (Acid Elution - AE) test is known to be an inaccurate method for estimation of TPH, subject to variation in film-making and staining technique, and misinterpretation by inexperienced members of staff. Laboratories relying on the Kleihauer test for estimating TPH should ensure that staff are appropriately trained and competent, and that the laboratory participates in regular National External Quality Assessment Service (NEQAS) exercises (as previously recommended by SHOT in the 2012 Annual SHOT Report (Bolton-Maggs et al. 2013).

The BCSH Fetomaternal Haemorrage (FMH) guidelines (BCSH Austin et al. 2009) state that any FMH greater than 2mL by AE should be confirmed by the Flow Cytometry (FC) method, using the original sample. If the FC result will not be available within 72 hours, the AE test should be repeated by a second operator before referral. In this case the AE results should be acted upon until the FC result is available.

SHOT Good Practice Point: The Kleihauer test should be repeated from scratch from the original sample – it is pointless a second operator assessing what may be a badly made or eluted slide.

Handling and storage errors relating to anti-D Ig n=4

Three of these four errors occurred in the clinical area and one was a laboratory error, all occurring in the hospital setting.

Case 17: Lack of understanding of sensitisation by blood components

A BMS issued anti-D Ig to cover D-positive fresh frozen plasma (FFP) given to a D-negative woman during a major haemorrhage (there are no cells in FFP to sensitise recipients).

Case 18: Alteration of laboratory report to 'fit' the hospital electronic record

Anti-D Ig was issued to the ward, but it was noted that some of the patient ID on the request and subsequent laboratory report did not match the hospital electronic patient record (EPR). Ward staff manually amended the laboratory issue report and traceability record so that the details matched those on the EPR.

Near miss anti-D Ig cases n=43

Similar lessons can be learnt from near miss Anti-D cases that were detected before the patient was put at risk of harm.

Point in the process	Type of error made	Number of cases	Percentage of cases
Request	Wrong volume requested	5	23.3%
	Requested for D-positive woman	3	
	Requested for woman with immune anti-D	1	
	Not requested	1	
Sample receipt	Entered to incorrect patient record	1	2.3%
Testing	Misinterpretation	2	7.0%
	Incomplete testing prior to issue	1	
Component selection	Issued for D-positive woman	10	53.5%
	Wrong volume issued	9	
	Issued to woman with immune anti-D	2	
	Issued to mother of D-negative baby	1	
	Wrong component selected (PCC*)	1	
Component labelling	Anti-D Ig mislabelled	5	11.6%
Collection	Time expired anti-D Ig available	1	2.3%
Total		**43**	**100%**

PCC = Prothrombin complex concentrate

Table 25.3: Near misses that could have led to errors related to anti-D Ig n=43

IT-related anti-D cases n=11

There were 11 cases that also had an IT element and these are described below. The numbers are included in the tables above where appropriate, so these are not additional cases. There were 7 clinical errors and 4 laboratory errors.

Table 25.4: IT errors relating to administration of anti-D Ig

Error	Reports	Unnecessary anti-D Ig administered	Failure to administer anti-D Ig	Anti-D Ig given to the right patient but with wrong patient details
Error when manually transcribing data	4	2	1	1
LIMS not updated with reference laboratory result	1	1		
Failure to consult historical record	3	3		
Failure to use flags, logic rules	1	1		
Discrepancy between electronic patient record or PAS and LIMS	2			2
Total	**11**	**7**	**1**	**3**

Unnecessary anti-D Ig involving IT errors n=7

Two D-negative women with immune anti-D were given unnecessary anti-D Ig. One occurred because the midwife who requested anti-D Ig assumed it was a passive rather than immune antibody and the BMS did not consult the LIMS when issuing the injection. The other occurred because the immune anti-D, although correctly recorded on the LIMS, was not flagged in such a way as to prevent anti-D Ig issue.

Four D-positive women were given anti-D Ig in error.

- One D-positive patient with the same name but the wrong DOB was selected from a computer pick-list and anti-D Ig issued in error
- Another D-positive patient was given anti-D Ig because the negative antibody screen was misread from a computer screen as a negative D-group
- Unnecessary anti-D Ig was given to a D-positive woman after a fall. The blood group was recorded on the electronic record and LIMS but neither IT systems were consulted before administration
- The last D-positive woman in this group was given anti-D Ig because the wrong group was transcribed into the notes and a check on the IT system was not possible because the look-up facility was not functioning properly

A woman with confirmed weak D was given anti-D Ig because the LIMS had not been updated with the reference laboratory report.

Omission of anti-D Ig involving IT errors n=1

One D-negative woman did not get RAADP because the wrong D group was manually transcribed into the patient record. It was reported that a bidirectional interface has now been implemented between LIMS and the EPR to transfer results electronically.

Handling and storage errors n=3

In three patients anti-D Ig was given to the right patient despite a discrepancy in patient demographic details (name, DOB, 1st line of address) between the LIMS and PAS.

Learning points and suggested actions

- Standardisation of laboratory reports so they cannot be misinterpreted
- Standardisation of patient records with electronic transfer of D-grouping results where possible

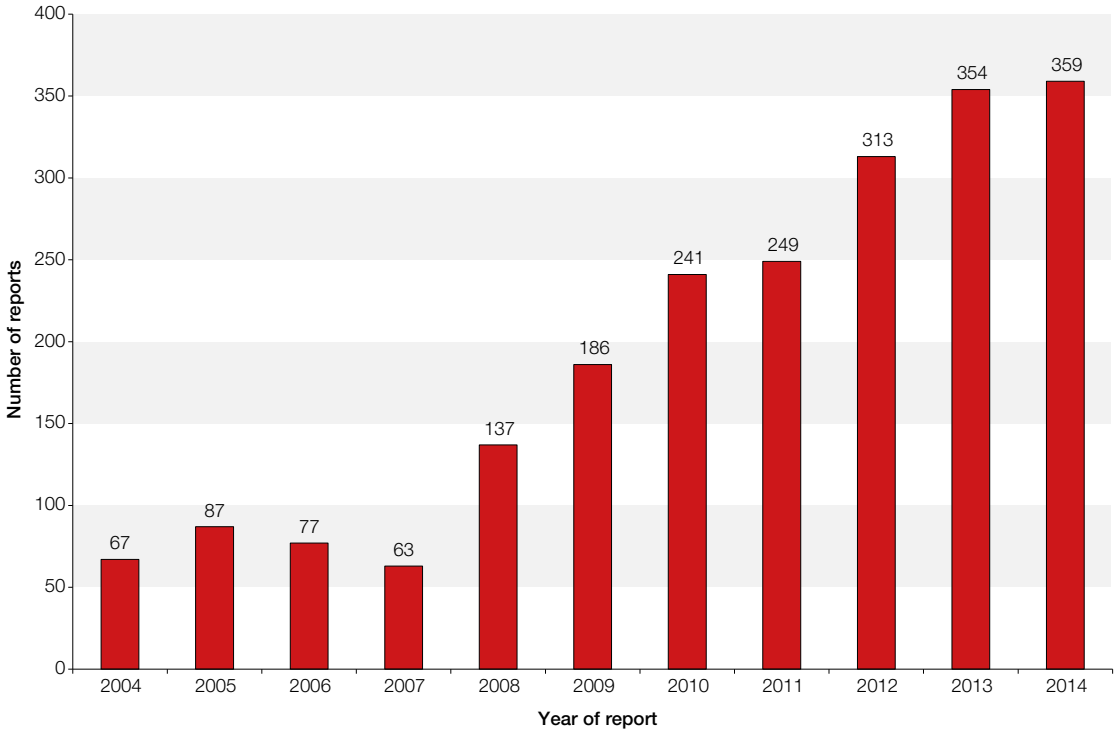


Figure 25.1: Cumulative data for anti-D events 2004-2014

Good practice points from previous years and examples of system failures are available in the 2013 report and on the SHOT website

References

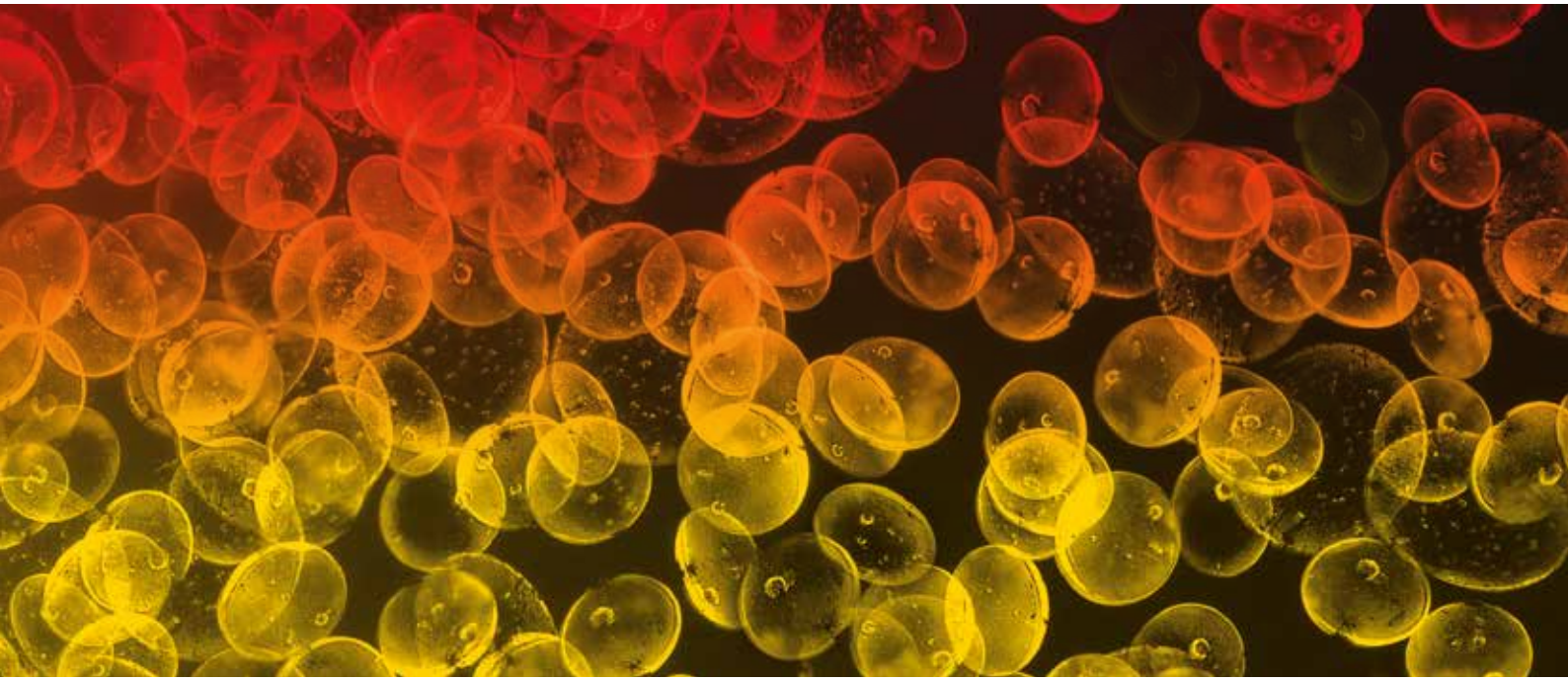
The Blood Safety and Quality Regulations (2005), ISBN 0110990412. http://www.legislation.gov.uk/uksi/2005/50/made [Accessed 30/03/2015]

BCSH Qureshi H, Massey E et al. (2014) **Guideline for the use of anti-D immunoglobulin for the prevention of haemolytic disease of the fetus and newborn**. Transfus Med 24, 8-20 http://onlinelibrary.wiley.com/doi/10.1111/tme.12091/pdf

BCSH Austin E, Bates S et al. (2009) **Guidelines for the estimation of fetomaternal haemorrhage**. (2009, under review 2015) http://www.bcshguidelines.com/documents/BCSH_FMH_bcsh_sept2009.pdf [Accessed 30/03/2015]

Bolton-Maggs PHB, Poles D et al. (2013) Annual SHOT Report 2012. www.shotuk.org

NICE (2012) **NICE Guidance on management of ectopic pregnancy and early miscarriage**. www.nice.org.uk/guidance/cg154 [Accessed 30/03/2015]



Web Edition: Chapters Relating to Other Clinical Reactions

26 Post-Transfusion Purpura (PTP) n=1

Author: Catherine Chapman

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.

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).

One case of confirmed PTP was reported this year. Three cases were initially reported but two were withdrawn because HPA alloantibodies were not found. This compares with 3 confirmed cases last year.

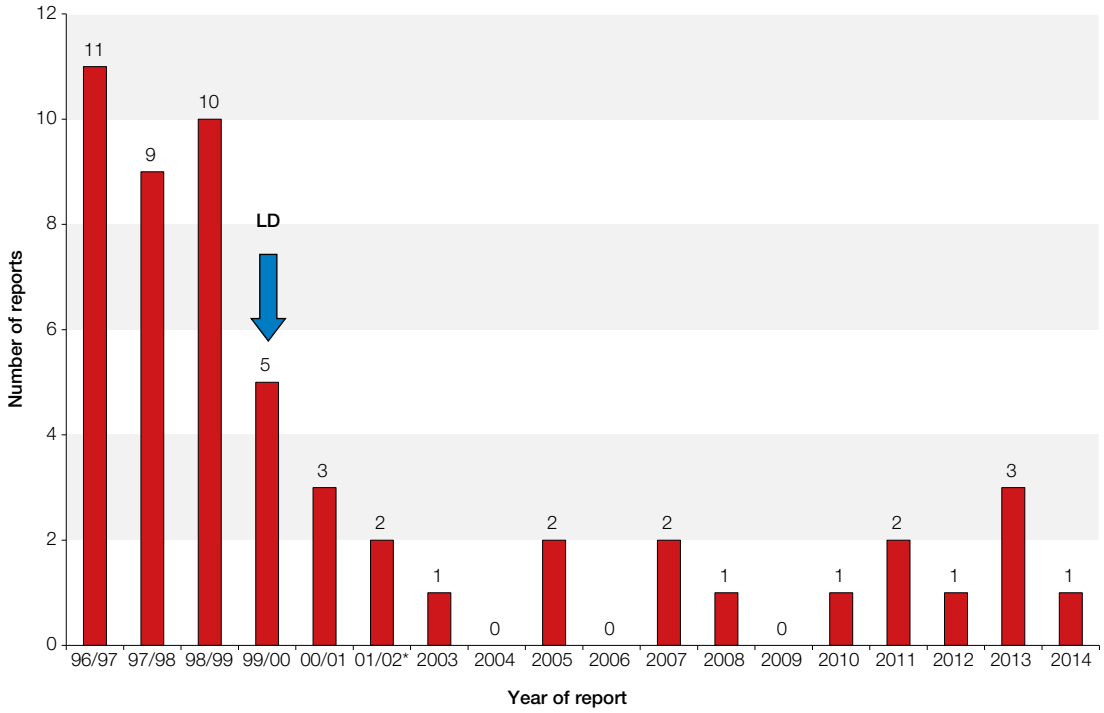


Figure 26.1: The number of cases of PTP with confirmed HPA alloantibodies reported annually to SHOT since 1996, a total of 54 reports. Cumulative data 1996 to 2014

LD indicates the introduction of leucodepletion in 1999

Analysis of cumulative data since 1996 has shown that there have been 54 cases of serologically confirmed PTP. Almost all, 53/54, 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 75.9% 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	36
HPA-1a with other HPA antibodies	5
Other HPA antibodies (HPA-1b,-2b, -3a, -3b, -5a, -5b and-15a)	13
Total	**54**

Table 26.1: Cumulative causative antibody specificity 1996-2014

Case 1: PTP follows transfusion of red cells postoperatively

A female patient aged 50 developed postoperative thrombocytopenia following bilateral mastectomy. She had been transfused with 2 units of red cells in optimal additive solution (RBCOA) to treat surgical blood loss. Her platelet count at the time of surgery was 161x10^9/L. Sixteen days after transfusion she had a routine review in an outpatient clinic and was then found to have a platelet count of only 3x10^9/L. Her only symptoms were purpura and bruising. She was readmitted to hospital and was treated with intravenous immunoglobulin (IVIg). Her platelet count had recovered to 100x10^9/L nine days later. She had had three pregnancies in the past but gave no history of neonatal alloimmune thrombocytopenia in any baby. Her recent postoperative transfusion had not been associated with any acute transfusion reaction. She made a full recovery and had suffered minor morbidity only.

Investigations: these showed that this patient had HPA-1a specific alloantibodies and that her HPA genotype was HPA-1b1b. These results confirmed the diagnosis of PTP.

Implicated component: RBCOA

COMMENTARY

The only confirmed case reported this year was diagnosed with PTP following a routine follow-up appointment and this could easily have been missed. PTP was caused by her HPA-1a alloantibodies which are the most frequent cause of PTP.

Advice on management of PTP is available in Practical Transfusion Medicine (Murphy et al. 2013).

Recommendations from previous years are available in the Annual SHOT Report 2014 Supplement located on the SHOT website, www.shotuk.org under SHOT Annual Reports and Summaries, Report, Summary and Supplement 2014.

Reference

Murphy M. **Post-transfusion purpura**. (2013) In Murphy M, Pamphilon D, and Heddle N, editors. Practical Transfusion Medicine. 4th ed: Wiley-Blackwell:127-30

27 Transfusion-Related Acute Lung Injury (TRALI) n=9

Author: Catherine Chapman

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.

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).

Recommendations

- UK Blood Services should avoid the use of female donor plasma in the production of cryoprecipitate whenever possible
- All UK Blood Services are encouraged to refer cases of suspected transfusion-related acute lung injury (TRALI) to the independent TRALI intensive care experts for assessment before laboratory investigations are initiated

Action: UK Blood Services

Number of reports: 9 cases of suspected TRALI have been included this year. The number of case reports this year is one less than in 2013. Three other cases were transferred to another SHOT category (2 transfusion-associated circulatory overload (TACO), 1 acute transfusion reaction (ATR)) and a further 2 were withdrawn because their respiratory deterioration was attributed to another cause (chest infection and haematemesis/pulmonary haemorrhage).

Patient outcomes

Deaths n=2

One patient died following 2 units of red blood cells in optimal additive solution (RBCOA). The clinical description of this event was consistent with TRALI but the serological investigations were negative. The initial event was classified as probable TRALI and it was assessed that TRALI had probably contributed to his death (imputability 2).

The second patient died following a small volume transfusion and results of serological investigation have been negative to date but are incomplete. The clinical picture included some features of cardiac impairment including raised jugular venous pressure (JVP) and cardiomegaly but reporters thought TACO was unlikely. This death was assessed as possibly related to TRALI (imputability 1).

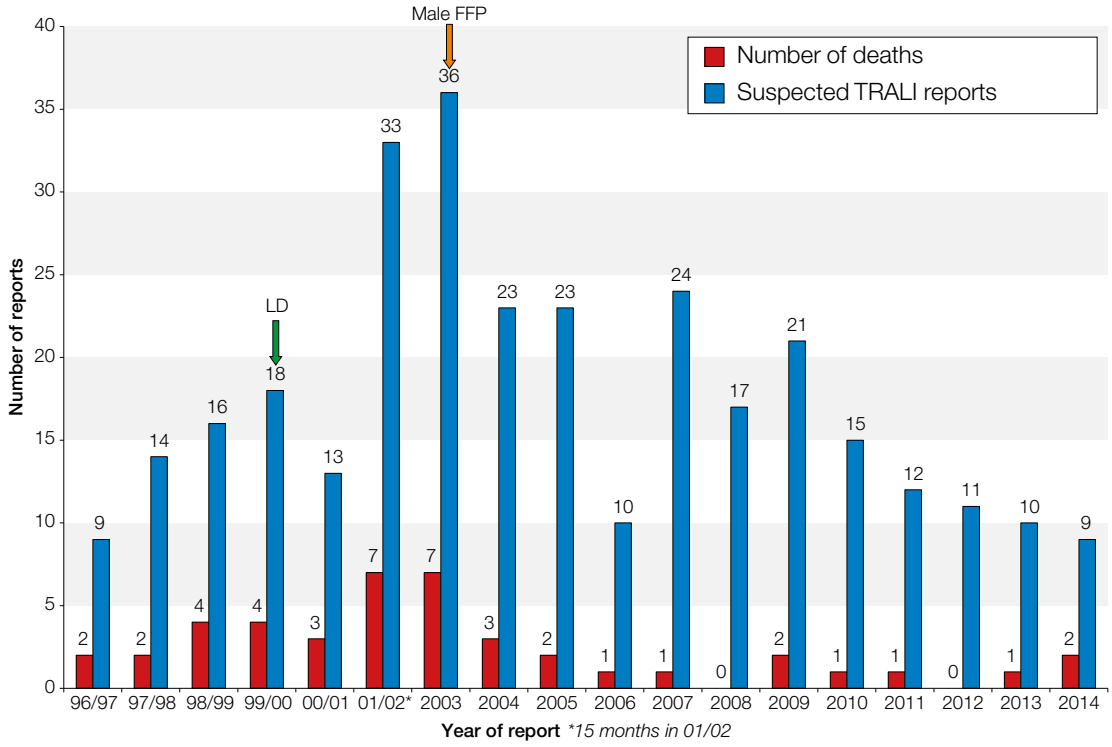


Figure 27.1: Number of suspected TRALI cases and deaths at least possibly related to TRALI by year of report

LD marks the time when universal leucodepletion was introduced (during 1999). Male FFP marks the date (from September 2003) when National Health Service Blood and Transplant (NHSBT) introduced use of male donor plasma only for fresh frozen plasma (FFP) and preferential use of male plasma for suspending pooled platelets. Hospital stocks of female FFP were not recalled at that time.

Major morbidity n=7 (recovery n=6)

All had life threatening acute reactions requiring immediate medical intervention.

One patient died 56 days after platelet transfusion. The initial event was classified as highly unlikely to have been TRALI and the patient's subsequent death was assessed as unrelated to TRALI (imputability 0).

The remaining 6 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 27.1. 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 NHSBT cases (4 of 9 cases) before laboratory investigation was initiated. Cases were subsequently categorised to take account of the laboratory results (as shown in Table 27.2):

Table 27.1: SHOT criteria for assessment of TRALI cases

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 27.2: TRALI case probability (SHOT criteria)

Probability	Number of cases
Highly likely	1
Probable	3
Possible	1
Unlikely	4
Total	**9**

Additional information is found in the Annual SHOT Report 2014 Supplement located on the SHOT website www.shotuk.org under SHOT Annual Reports and Summaries, Report, Summary and Supplement 2014.

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 1 to 75 years.

Clinical specialty

The referring specialities were: haematology 5 cases; surgery 2 cases; obstetrics 1 case; oncology 1 case.

Clinical presentation

All patients were hypoxic and had bilateral changes on chest X-ray (CXR). Seven patients were treated in the intensive therapy unit (ITU). Six of these required full mechanical ventilation for 1,1, 2, 8 and 56 days respectively; duration of mechanical ventilation was not reported in 1 case. Fever was present in 2 and absent in 7 patients. Hypotension was present in 3 and absent in 6.

Laboratory investigations

Complete results were available for 7 patients, 1 case was not investigated because the only donor had been an untransfused male donor and 1 investigation was incomplete because it was a very recent incident. Concordant donor human leucocyte antigen (HLA) or granulocyte specific antibodies were found in 3 cases, the antibody specificities are tabulated below in Table 27.3. Concordant donor antibodies were excluded in 4 cases.

Table 27.3: Concordant donor antibodies 2014 - specificities and implicated components

Donor antibody	Concordant antibody specificities	Component	Other risk factors	Outcome
HLA class I and II	B27 and DR4	RBCOA	Cardiac dysfunction, renal impairment, high white cell count	Full recovery
HLA class I and II	B44, DR4, DR13, DR52, DR53, DQ7 and DR13	Cryoprecipitate: 3 female donors had concordant antibodies RBCOA: 1 female donor had concordant antibodies	Haemorrhagic shock and massive transfusion	Full recovery
HLA class II	DR7	RBCOA	Positive fluid balance	Full recovery

Patients who have suspected TRALI are no longer tested for leucocyte antibodies unless granulocytes have been transfused. This is because all other UK blood components are leucodepleted.

Cumulative serological data

Since 1996 there have been 195 of 314 reported cases which have had full laboratory investigation for TRALI. Concordant antibodies were identified in 113/195 (57.9%) of these. The most frequently identified antibody specificities (either alone or in combination with other concordant antibodies) have been HLA-DR4 (21/113 cases, 18.6%), HLA-DR52 (17/113, 15.0%) and HLA-A2 (17/113, 15.0%). All other HLA antibody specificities have been identified in less than 10% of cases. Concordant human neutrophil antigen (HNA) specific antibodies, alone or in combination, have been found as follows: HNA-1a (9/113 cases, 8.0%); HNA-2 (1/113, 0.9%); HNA-3a (2/113, 1.8%).

Analysis of reports of 175 complete TRALI investigations between 2001 and 2014 inclusive has shown that the specificities of concordant antibodies were as follows:

HLA class I alone	HLA class II alone	Both HLA class I and HLA class II	Granulocyte specific antibody	None identified
18/175 (10.3%)	36/175 (20.6%)	27/175 (15.4%)	17/175 (9.7%)	77/175 (44.0%)

Table 27.4: Concordant donor antibodies 2001 to 2014 inclusive

Classification of cases according to Canadian consensus criteria (Goldman et al. 2005; Kleinman et al. 2004)

All 9 reports have also been classified using the Canadian consensus criteria to allow international comparison. Using these criteria 1 case was classified as TRALI, 5 as possible TRALI and 3 were classified as not being TRALI because there was a history of fluid overload.

Case 1: Highly likely TRALI

A healthy 22 year old woman had a 3L postpartum haemorrhage (PPH) after an elective caesarean section. She was transfused with 4 RBCOA, 4 FFP and 2 cryoprecipitate pools. Within 10 minutes of starting the cryoprecipitate transfusion she developed difficulty breathing and became cyanosed. Her oxygen saturation was 64%, respiratory rate 30, pulse 125 and her blood pressure (BP) increased. Her pO2 was then 10.5 Kpa on 100% oxygen 50L/min and she was transferred to ITU on continuous positive airway pressure (CPAP). She was treated with 80mg furosemide and had a 2L diuresis but her condition worsened. Her chest X-ray showed patchy consolidation throughout both lungs. On the next day her respiratory function deteriorated further and she required intubation. She was ventilated for one day and then made a full recovery.

Laboratory investigation identified multiple HLA antibody matches between donors and this patient:

3 female cryoprecipitate donors had concordant antibodies:

- Donor 1: HLA class II (DR4, DR53, DQ7)
- Donor 2: HLA class I (B44)
- Donor 3: HLA class I (B44) and class II (DR4, DR13, DR52)

1 female RBCOA donor had concordant antibodies

- Donor 4: HLA class II (DR13, DR52)

Implicated components: pooled cryoprecipitate and red cells. (Pooled cryoprecipitate contains approximately 40mL of plasma from each donor).

Case 2: Probable TRALI

A 60 year old woman was admitted following a splenic tear during colonoscopy. She had a history of chronic obstructive pulmonary disease, hypertension and also myocardial infarction 4 years previously. She was on regular treatment with aspirin, atorvastatin, bisoprolol, carbocisteine, escitalopram, ipratropium bromide, ramipril, isosorbide mononitrate, nitrazepam, tiotropium, seretide, salbutamol, ferrous fumarate, erythromycin and paracetamol.

She went into theatre at 10:00 stable on oxygen (2L/minute) and 3 hours later was admitted to ITU with a PaO2 of 7mmHg. She had developed dyspnoea, increased respiratory rate, increased pulse rate from 74 to 94, increased BP from 94/59 to 142/85. She was treated with furosemide (20mg IV) and bronchodilators with 1180mL diuresis but continued to deteriorate. Her oxygen requirement increased and she required mechanical ventilation for 8 days. The components transfused within 6 hours of onset of respiratory symptoms included 4 units red blood cells (RBC), 3 units platelets and 4 FFP. Total components transfused included 8 units of RBCOA (2132mL) with rate reported as 'stat', 3 packs of apheresis platelets (600mL), 4 solvent detergent (SD)-FFP (1000mL) and 3100mL crystalloid. Her fluid balance was reported as +2392mL. Her electrocardiogram showed ST and T wave abnormality and her CXR after surgery showed the development of patchy bilateral lung consolidation which was a new finding.

The clinical picture was consistent with either TACO or TRALI. She made a full recovery from this event.

Investigation Summary:

Four female donors were investigated; the other donors were untransfused males. One female red cell donor was found to have HLA class II antibody with specificity for DR7.The patient was found to have antigen DR7, concordant HLA-DR7.

Likelihood of TRALI: This was classified as PROBABLE TRALI according to SHOT criteria because concordant HLA class II antibody was transfused within 6 hours of her respiratory deterioration and the clinical picture complied with the TRALI definition. However, the history was also very suggestive of TACO which remains possible.

COMMENTARY

Three patient deaths were reported. One was assessed as probably due to TRALI, another as possibly related and the third as unlikely to have been caused by TRALI.

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. The cryoprecipitate pools contained 3 donations from females which contained HLA antibodies with 6 concordant specificities.

All UK Blood Services now use male donors to provide 100% FFP and plasma for platelet pooling. This practice should, if possible, be extended to cryoprecipitate production across all UK Blood Services.

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 four years.

All reported cases this year also had additional risk factors for respiratory deterioration.

Case 2 demonstrates the difficulty which can occur in differentiating TRALI from TACO. Very detailed clinical assessment is required to help differentiate these two adverse events which present with very similar clinical pictures.

References

Goldman M, Webert KE, et al. (2005) **Proceedings of a consensus conference: Towards an understanding of TRALI**. Transfus Med Rev 19, 2-31

Kleinman S, Caulfield T, et al. (2004) **Towards an understanding of transfusion-related acute lung injury: statement of a consensus panel**. Transfusion 44, 1774-1789.

Cell Salvage (CS) n=16

28

Authors: Joan Jones and Dafydd Thomas

Definition:

Any adverse event or reaction associated with autologous transfusion including intraoperative and postoperative cell salvage (washed or unwashed), acute normovolaemic haemodilution or preoperative autologous donation.

In addition specific definitions for cell salvage events are as follows:

- **Adverse events due to operator error, machine failure and non-availability of trained staff where the event impacts on the care of the patient**
- **Adverse clinical events during the cell salvage process**
- **Pathological reactions to reinfused blood**

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).

Sixteen cases were reviewed and none was withdrawn. No case was transferred to another category. There were no reports of adverse events related to acute normovolaemic haemodilution or preoperative autologous donation.

Specialty involved in the event

The 16 cases were distributed across the following specialties:

- 7 orthopaedic
- 3 vascular
- 5 obstetric
- 1 urology

Adverse reactions n=3

3 adverse reactions were reported

Case 1: Total knee replacement

Fifteen minutes after starting reinfusion of unwashed red cells the patient started to become short of breath, complained of chest pains, became hypotensive, nauseous and was feeling anxious. The transfusion was stopped, the patient was given paracetamol and 100% oxygen and a chest X-ray was requested. Within 2 hours the patient had recovered and was under close observation.

Case 2: Caesarean section

The patient had 1.5L blood loss. The decision was made to use salvaged blood. The woman suffered an episode of hypotension (with severe nausea and vomiting) when the salvaged blood was reinfused. Sodium chloride 0.9% was given using the same administration set as was used for reinfusion of salvaged blood. A skin rash was noted around the intravenous cannula site. The patient was given chlorphenamine to treat the allergic reaction and 40% oxygen was administered. The patient made a complete recovery.

Case 3: Radical cystectomy

Cell salvaged blood was infused with a leucocyte filter in situ using acid citrate dextrose (ACD) as the anticoagulant. A profound fall in blood pressure (BP) to 60/40mmHg occurred which was unresponsive to vasopressors. The transfusion was stopped and BP recovered. The transfusion was restarted 3 times with a fall in BP each time. The leucocyte filter was then removed and the reinfusion restarted with no hypotension.

Excessive time to reinfuse n=2

In 2 cases of postoperative cell salvage the red cells were reinfused >6 hours after collection.

Machine failure n=8

Six of these 8 machine failures were reported by one reporting organisation.

The centrifuge bowl leaked causing contamination in four cases (2 reported to Medicines and Healthcare products Regulatory Agency (MHRA) devices). There was a failure of suction in 3 cases (2 reported to MHRA devices). There was one reported fault which was not fully described (reported to MHRA devices).

The MHRA is currently investigating the reports of various leaks in bowls sent to them and it should be noted these are not machine faults.

Operator error n=1

Inappropriate use of suction (contaminated area) = 1

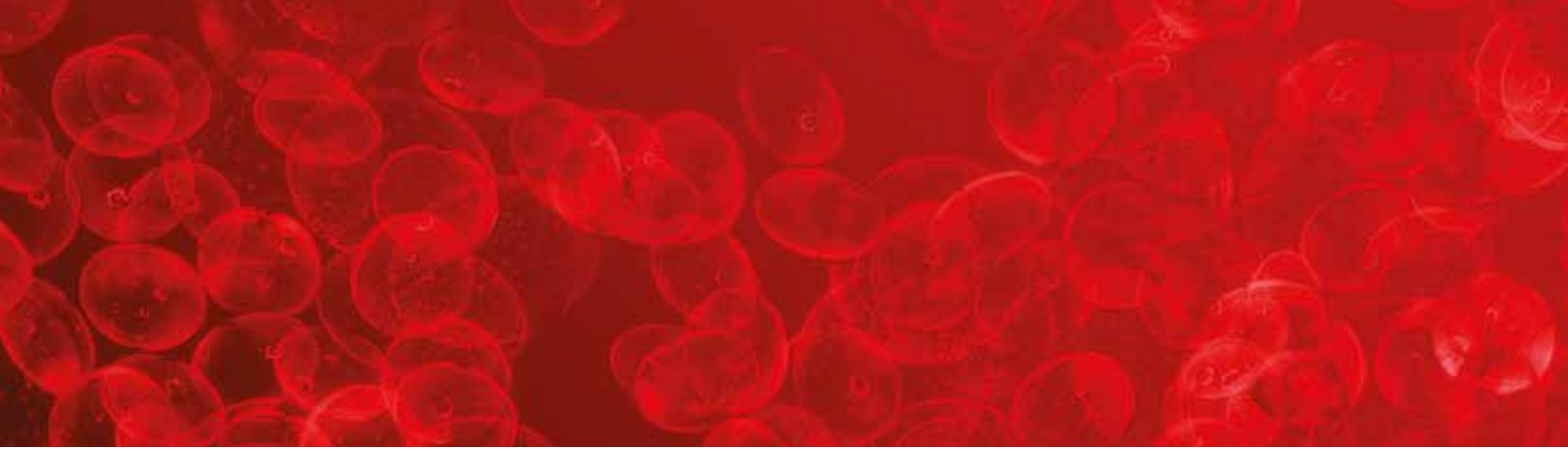
COMMENTARY

Completed reports this year exclusively relate to cell salvage and not other autologous techniques, which are now less popular. Cell salvage using modern equipment is clearly very safe as the denominator (number of cell salvage procudures) is very high. Cell salvage is now standard of care in many specialties with a good safety record which should encourage its use if clinically indicated.

In 15/16 cases the reported cases were reviewed by the Hospital Transfusion Team/Hospital Transfusion Committee or other appropriate group e.g. cell salvage group or anaesthetic clinical group.

It is reassuring that the pattern of reports remains the same and that the low level and consistent problems reported have helped to encourage increased use as well as improved recognition and treatment of the adverse events.

No fatality has been reported due to cell salvage in either obstetric haemorrhage or use in urological surgery.



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