20 Paediatric Cases n=122 (excluding NM and RBRP)

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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).

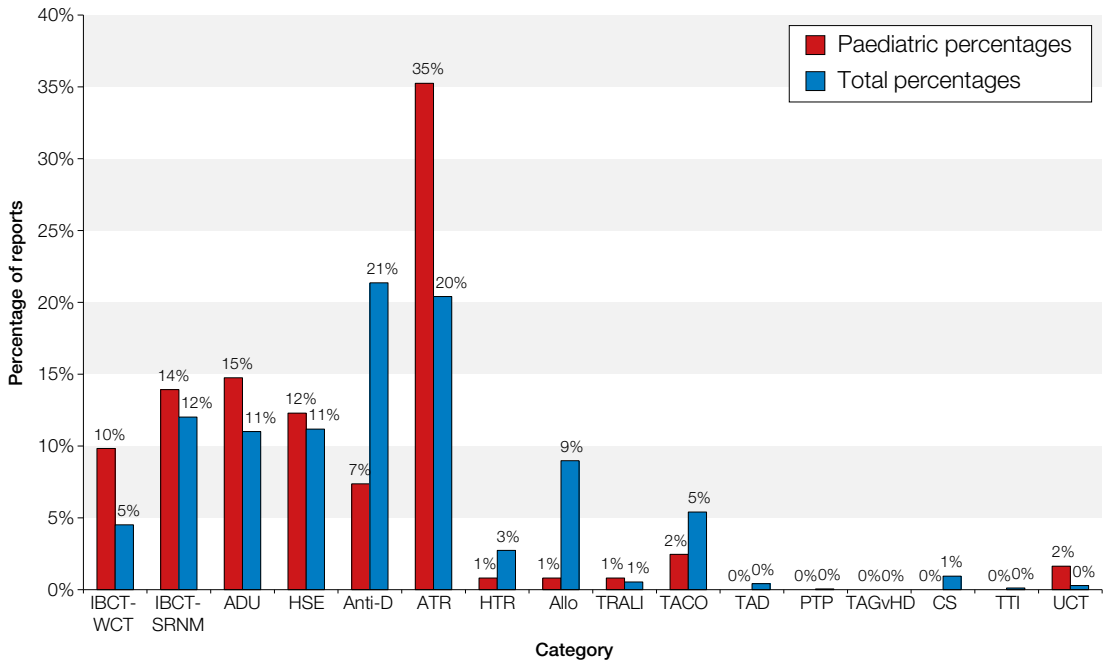
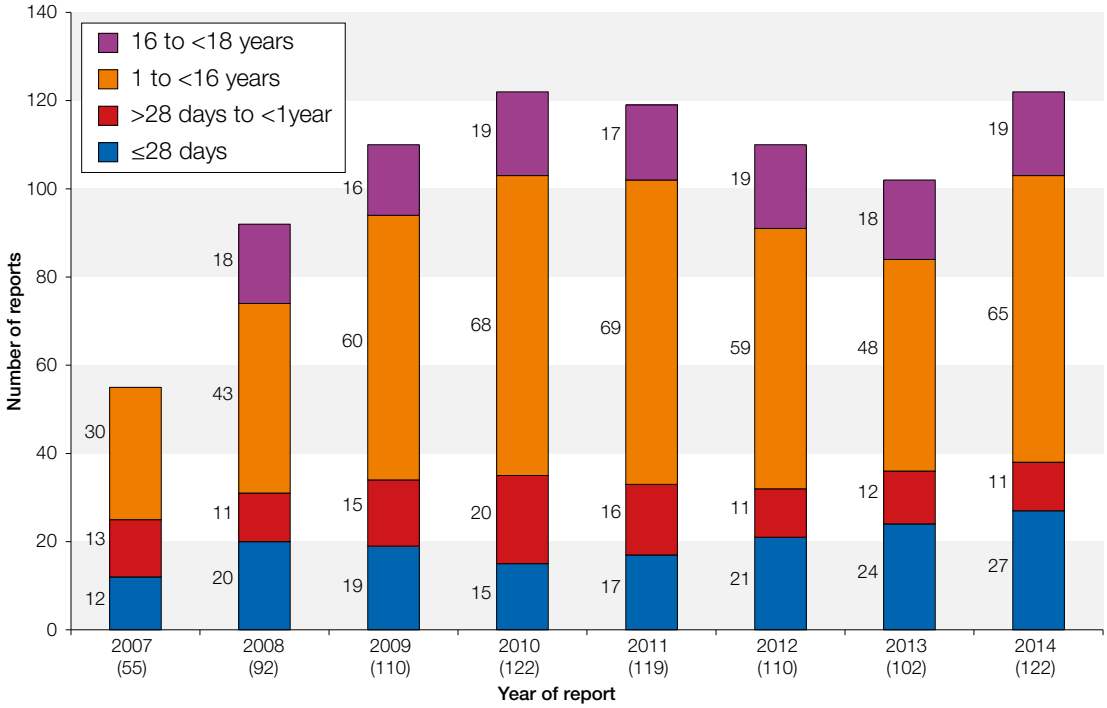


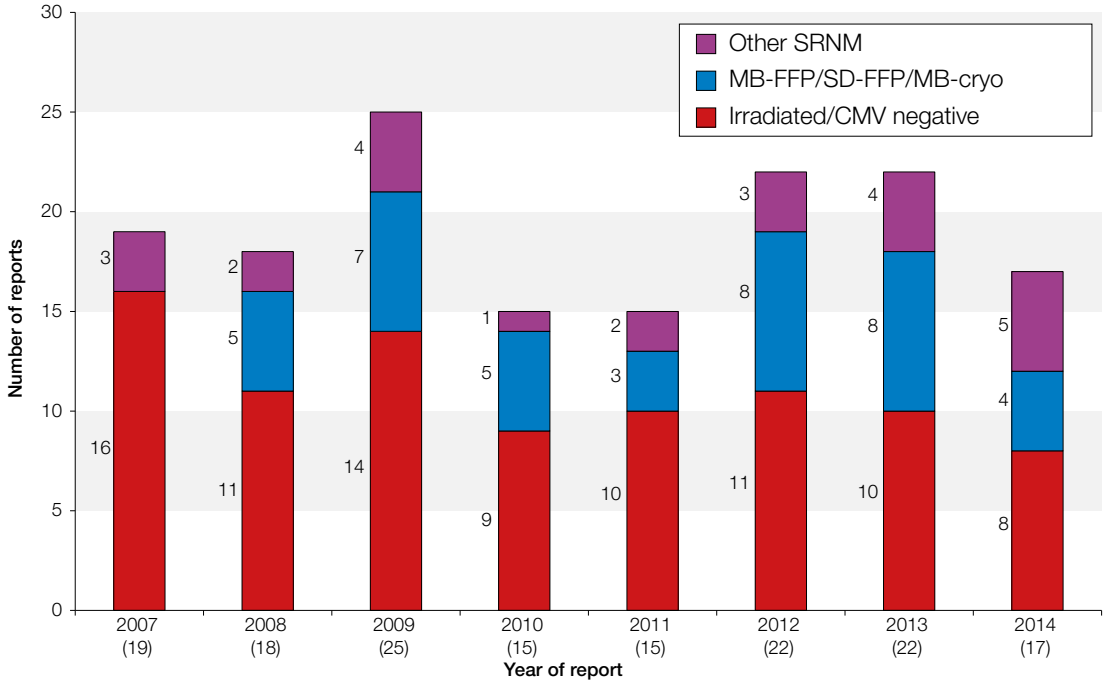
Figure 20.1: Percentages of paediatric and total reports in each category

Figure 20.2: Trends in paediatric reports 2007-2014

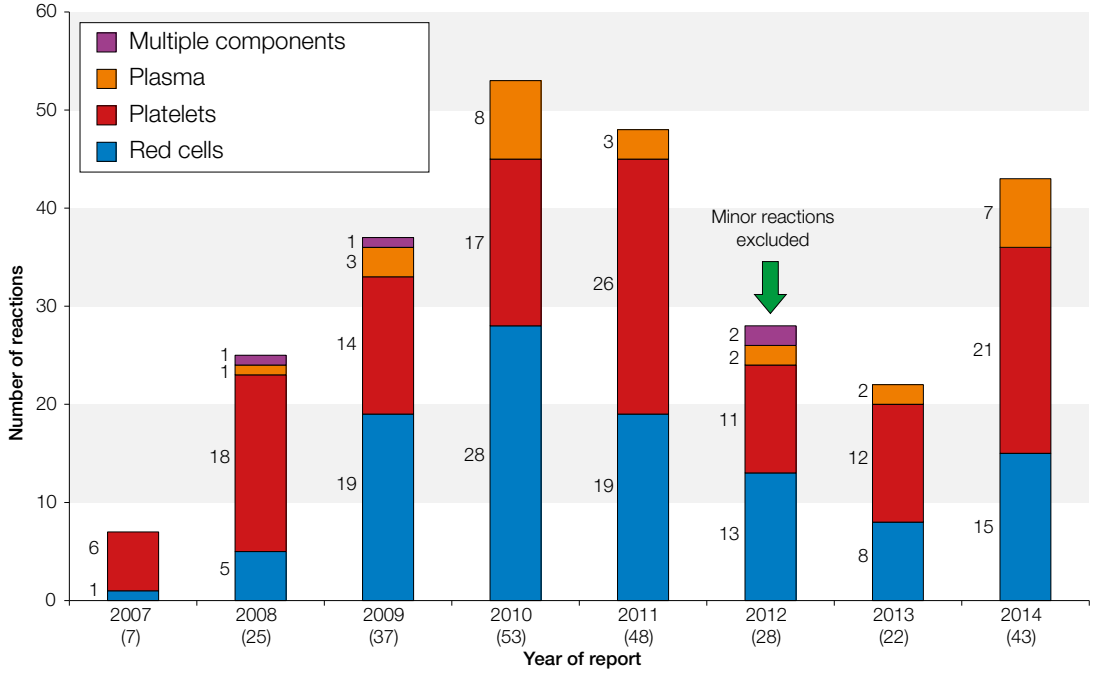
a. Total numbers of paediatric reports (excluding RBRP and NM reports)



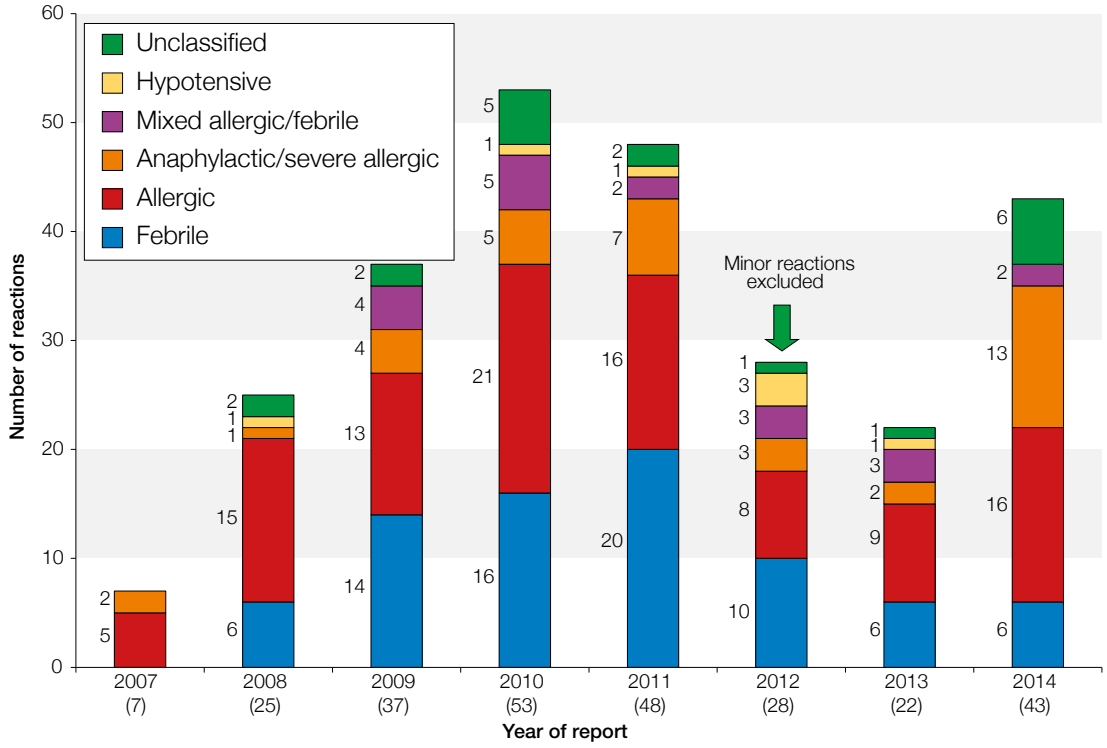
b. Paediatric reports where specific requirements were not met



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

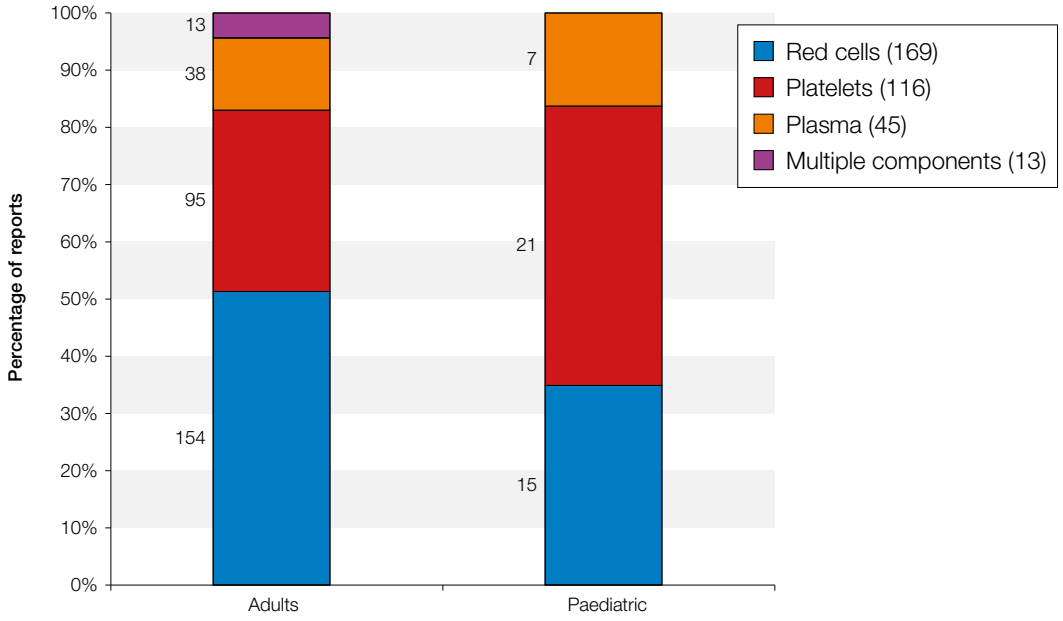
A septic, preterm neonate (29 weeks gestation) developed bradycardia, became hypotensive and desaturated during transfusion of FFP. The transfusion was stopped and the baby required adrenaline and hand ventilation for a few minutes before stabilising back on the ventilator.

Other reactions to plasma:

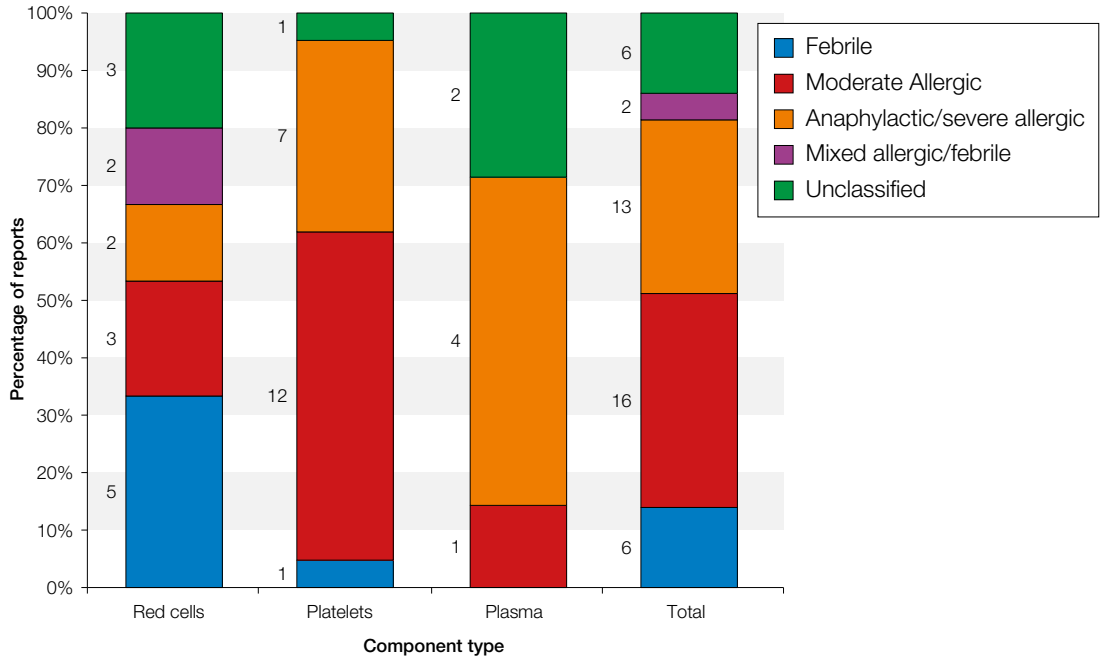
- A patient with a single factor deficiency had two MB-FFP reaction reports (including 1 severe allergic) He/she was being treated with FFP in the community, and had also experienced a severe allergic reaction to SD-FFP in the past
- An 11 year old had a moderate allergic reaction to MB-FFP
- A 16 year 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]

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