19. Paediatric Cases

Definition

Paediatric cases comprise all those occurring in patients under 18 years of age.

This chapter analyses the data on paediatric cases from the other chapters in this annual report. All the cases are also included in the data in their respective chapters. All children < 18 years of age are included and have subdivided by age bands within this: neonates ≤ 4 weeks old, infants > 4 weeks and < 1 year old, and children > 1 year and < 16 years old because each of these has specific recommendations regarding blood components. The chapter particularly highlights the cases related to the age of the patient.

Table 56

Category of case	No. ≤ 4 weeks	No. > 4 weeks to <1 year	No. 1 to < 16 years	No. 16 to < 18 years	Total paediatric cases
IBCT	**15**	**6**	**14**	**4**	**39**
Administration	5	0	2	1	8
Laboratory error	5	2	2	2	11
Special requirements not met (total)	3	4	10	1	18
Irrad/CMV negative	*2*	*4*	*4*	*1*	*11*
MB requirement	*1*	*0*	*4*	*0*	*5*
Others	*0*	*0*	*2*	*0*	*2*
Miscellaneous	2	0	0	0	2
Handling and Storage	**4**	**1**	**2**	**1**	**8**
Inappropriate/unnecessary	**0**	**3**	**2**	**2**	**7**
Anti-D related	**0**	**0**	**0**	**4**	**4**
ATR	**1**	**1**	**20**	**3**	**25**
HTR	**0**	**0**	**3**	**1**	**4**
TACO	**0**	**0**	**0**	**0**	**0**
TRALI	**0**	**0**	**0**	**2**	**2**
PTP	**0**	**0**	**0**	**0**	**0**
TA-GvHD	**0**	**0**	**0**	**0**	**0**
TTI	**0**	**0**	**0**	**1**	**1**
Autologous	**0**	**0**	**2**	**0**	**2**
Total	**20**	**11**	**43**	**18**	**92**

Introduction and overall trends

In 2008, 92 of the total 1040 reports (8.8%) involved patients < 18 years old. Furthermore, a total of 74/1040 (7.1%) were in children < 16 yr, 31/1040 (3.0%) reports were in infants < 1 yr, and 20/1040 (1.9%) in neonates ≤ 4 weeks. The overall number of reports has increased compared to previous years, particularly in the older age groups, but when compared with the summary data from the first 9 years of SHOT,[34] and the paediatric chapters in 2003 and 2007, the percentage of paediatric cases in 2008 is lower (Table 57). However, there are not sufficient data from consecutive years to make clear conclusions from these trends, and there is almost certainly under-reporting, particularly in the younger age groups.

There were a relatively high proportion of reports in the < 1 yr age group (31/92; 34%) of whom 20/31 (65%) were neonates ≤ 4 weeks old. This is consistent with the epidemiological survey of transfused patients in 2004, which showed that 4.2% red cell units were transfused to patients < 18 years, and 1.7% to infants less than 1 year,[34,35] i.e. infants received 40% of paediatric red cell units. However, these epidemiological data also suggest that there are still a disproportionately high number of paediatric reports compared to adults in both the < 18 yr and < 1 yr groups.

Table 57
Cumulative paediatric numbers and percentages

	1996–2005 [34] Number (%)	**2003** Number (%)	**2007** Number (%)	**2008** Number (%)
Total reports analysed	3239	449	561	1040
< 18 yr	321 (9.9)	59 (13.1)	-	92 (8.8)
< 16 yr	-	-	55 (9.8)	76 (7.3)
< 12 mths/1 yr	147 (4.5)	29 (6.5)	25 (4.5)	31 (3.0)
< 4 wks/1 mth	96 (3.0)	20 (4.5)	12 (2.1)	20 (1.9)

NB Age limits are < 12 mths/1 yr and < 4 wks/1 mth depending on the year of the report. In 2007, only reports of patients < 16 yr were included in the paediatric analysis.[34]

There was an age related pattern in the types of reports (Table 56). Error reports (incorrect blood component transfused, inappropriate and unnecessary transfusion and handling and storage errors) dominated in infants < 1yr, with 29/31 (94% of all infant reports), and were also disproportionately represented, overall comprising 54% of the 54 total paediatric error reports. Moreover, administration and laboratory error reports were most common in neonates ≤ 4 weeks old, accounting for 10/19 (53%) of the total paediatric administration and laboratory errors. In comparison, for ages 1yr to < 18yr only 25/61 (41%) reports were in error categories and ATR accounted for a further 23 (38%); the majority of paediatric ATR reports (92%) were in this age group. The 16 to < 18 yr group had reports in categories not found at earlier ages: anti-D, TRALI and TTI. Some of the age associated differences in error reports are related to the complexity of neonatal transfusion. The lack of transfusion reaction reports in infants may be due to their immunological immaturity. However, there may also be significant bias from under reporting of events such as ATR, TACO and TRALI in infants owing to lack of recognition of these in babies who are already very sick from other causes.

Overall, the majority of paediatric reports were error related, these comprising 54/92 (59%) of the total in 2008. This can be compared with the overall figure for adults of 45%, while overall in the whole report the percentage of error-related reports is 46%.

The largest error-related subgroup in paediatrics was SRNM with a total of 18 cases, followed by laboratory errors in 11 cases. Just over half (28) of the error reports were specifically related to the young age or small size of the patient, and special requirements arising from this (i.e. paediatric related). Unfortunately there has been little change in the total number of error reports in recent years despite efforts to increase awareness of paediatric transfusion issues. This is likely to reflect ongoing lack of knowledge and expertise regarding transfusion special requirements and administration for this complex group of patients. However, it is encouraging that these errors (59% of paediatric cases) compare favourably with the proportion of errors in the paediatric cases in previous years. In the 1996–2005 paediatric summary data errors accounted for 264/321 (82%) of paediatric cases, in 2003 errors accounted for 53/59 (90%) and in 2007 errors in under-16s accounted for 45/55 (82%) of the total paediatric cases. However, a possible factor appears to be the increase in the non-error reports (predominantly ATR) in the older age groups.

ATR cases made up the largest category of non-error reports in 2008 and accounted for 25/92 (27%) of all paediatric cases. This was a striking increase compared with previous years: 30/321 (9%) in the 1996-2005 summary data, 3/59 (5%) in 2003, and 7/55 (13%) in 2007 (see ATR section below).

Error-related reports *n* = 54

IBCT – Special requirements not met (SRNM) *n* = 18

The largest subgroup of paediatric reports involving errors was, as previously, SRNM with a total of 18 cases. These were mostly failure to give irradiated and/or CMV negative components or methylene blue FFP. Six of the 7 reports in infants < 1 yr were a failure to give irradiated components; 4 of these were for cardiac patients. The 10 reports from 1 to < 16 years combined failure to give MB-FFP and CMV negative components, with 1 each of failure to give apheresis platelets, sickle negative red cells for a patient with sickle cell disease, or an irradiated component. The underlying diagnosis in this age group was mostly solid tumour, haematological malignancy or bleeding.

The variation in the SRNM errors in the different age groups reflects the different underlying diagnoses, and also that it is less likely that non-MB-FFP will be selected for a small infant than for older children, as small-volume 'neonatal' FFP packs are all MB treated. In some cases, particularly in the older age groups, the SRNM was not specifically related to the patient being a child, for example needing irradiated components post fludarabine. Although errors at all stages of the transfusion process were contributory, the laboratory played a central role in 14/18 of the SRNM cases.

In the past SRNM accounted for 85/151 (56%) of error reports in 2003–2005,[34] 19/45 (42%) in 2007, and 19/54 (35%) in 2008. This is a possible downward trend but the numbers have shown no improvement over the last year and SRNM still represent a substantial proportion of all paediatric error reports.

IBCT – Laboratory error *n* = 11

The second largest subgroup of error reports were laboratory errors (11/54), of which 7 were in infants < 1 yr of age, all of whom were < 31 days old. Many of the cases could have occurred in any age group (see Chapter 6) and included 2 separate events where 'special' components were ordered from the NBS for 2 patients at the same time and the wrong component was issued by the laboratory. However, aspects of the errors were likely to have been paediatric related in 6/7 of the cases in infants < 1 yr. Three of these cases involved errors in providing red cells for infants < 1 month of age without crossmatching against the maternal sample, despite previous information that the mothers had antibodies. In one case a D positive paedipak was wrongly issued to a D negative infant.

Case 1

Infant given D-incompatible red cells due to assumption that paedipaks were all D negative

A 30-day-old group AB D negative infant required a red cell top-up transfusion. Only group O D negative paedipaks were routinely stocked in the hospital. However, on this occasion there were some D positive paedipaks stored within the same location as the D negative packs. The BMS issuing the blood out of hours selected units based on the expectation that only group O D negative units would be there. During the selection and issuing phases the fact that the blood was group O D positive was not realised, despite the hospital's computer software warning users when issuing across D group.

This is not the first time that an error of this type has occurred, and emphasises the need for particular care in hospitals that use group O D positive as well as group O D negative paedipaks.

In addition to reports in the laboratory error category, the laboratory also contributed significantly to errors in other categories: 14/18 SRNM and 4/8 HSE reports. This gives a total of 29/92 (32%) paediatric reports in which laboratory error was a major factor.

IBCT – Administration *n* = 8

Five of the 8 (63%) paediatric administration errors were in neonates ≤ 4 weeks old. In 3 of the neonatal cases, adult group O D negative blood was collected by nursing staff for perinatal resuscitation rather than blood stocked specifically for neonates. In another neonatal case, blood was given by mistake to the twin sister of the intended recipient, an error most likely to occur on neonatal units. The 3 non-neonatal cases were in patients between 10-17 years of age and did not involve paediatric-related scenarios. Two were instances of erroneous bedside checking.

IBCT – Miscellaneous *n* = 2

In the first case a neonate was grouped as B D positive on one occasion and subsequently group O D negative following large volume transfusion with group O D negative blood. Two different medical record numbers were used for these samples as a result of the way in which the hospital and neonatal computer systems interacted, so the laboratory had no indication that they were from the same baby. Group O FFP and platelets were issued and transfused but there was no evidence of haemolysis as a result. This case illustrates potential difficulties in patient identification as the result of having multiple separate computer systems.

The second case in this group related to an omission of antenatal testing at 28 weeks' gestation, resulting in transfusion of an inappropriate unit of S-positive red cells to a neonate whose mother had anti-S.

Both of these are discussed in the IBCT chapter on page 32.

Handling and storage errors (HSE)

There were 8 paediatric HSE reports, of which half were in neonates ≤ 4 weeks old. In 2 cases, there were problems with neonatal exchange units being used when more than 5 days old, due to a combination of older units being selected by the NBS and this not being detected by the hospital laboratories. In 5 of the 8 cases the problems were not specifically paediatric related.

Half the HSE cases could be attributed primarily to laboratory error, and the other half to ward error or a combination of the two.

Inappropriate and unnecessary transfusion

There were 7 reports of inappropriate and unnecessary transfusion in children, none of which were to neonates ≤ 4wks. Two of the 3 cases to infants < 1 yr were of transfusion on the basis of an incorrect Hb result; in 1 the result was from another baby and in the other the sample came from an arm with a drip running. In the third infant there was a failure to check that they had already been transfused (see I&U Chapter 7). There were 2 cases of excessive red cells transfusions to a 1-year-old and a 2-year-old. Both transfusions were to oncology patients but one of these occurred at the shared care centre, illustrating the need for good communication and training.

Case 2

Inappropriate prescription of red cells for a small child in 'units' instead of calculated volume

A 2-year-old child, small for her age and under shared care for treatment of a solid tumour, needed a transfusion. The central hospital requested that the shared care unit transfuse the child with 2 paedipak units of red cells. This was translated on the transfusion request form and prescription sheet as '2 units', without stating the volume required. Two adult units were issued and transfused without adverse reaction. However, the child was found to have a high Hb four days later and was subsequently venesected.

Case 3

Unfamiliarity with paediatric prescribing results in serious overtransfusion of a small child

A 1-year-old child required a transfusion as part of treatment for a malignancy. The blood was requested and prescribed by a doctor who was not familiar with the patient. A pre-filled request form was signed by the doctor without checking the notes for the volume required. The information on the request form was then used to complete the prescription with no consideration given for estimating the volume of blood according to the patient's weight. The patient had a post-transfusion Hb of 18.3 g/dL.

Both these cases illustrate a lack of understanding of the need to request and prescribe the correct weight-related volume to be transfused for children, instead of 'units' as prescribed for adults. These cases also highlight the absence of a requirement by laboratories to have a specific component volume requested for paediatric transfusions.

The final 2 cases in this category were 16–17-year-olds transfused on the basis of erroneous results (1 a blood gas Hb, and 1 an incorrect platelet count due to platelet clumping).

Non-error related reports *n* = 38

ATR

This is by far the largest category of the non-error paediatric reports, with 25 cases in 2008 (27% of all paediatric SHOT reports, the same proportion as in adults). Only 1 was from a neonate, with the majority of cases (23/25) occurring in children ≥ 1 year old. ATR accounted for 23/61 (38%) of all cases for the ≥ 1 year age group, a striking increase from previous reports both in the absolute number and proportion of ATR reports in this age group (2/30 in 2003 and 5/30 up to 16 years, in 2007).

The small numbers of ATR reports from the < 1yr age group may either reflect a lack of recognition of reactions or the immunological immaturity of infants.

In children the majority of reactions (18/25; 72%) followed platelets with 14 of these relating to apheresis platelets. Most paediatric reactions to platelets were to apheresis platelets rather than buffy-coat derived pools (14/18, 78%), consistent with the fact that most platelets given to children are from apheresis donors. However, this figure also demonstrates that some children are still receiving non-apheresis platelets.

Paediatric reports account for 26% of all ATR reports related to platelets. The EaSTR Study (Epidemiology and Survival of Transfusion Recipients) of transfusions in 29 representative hospitals over a 12 month period in 2001–02 showed that 4% RBC, 13% platelets, and 9% of FFP transfusion recipients were children < 16 years of age.[36] This suggests that the number of paediatric ATR reports due to platelets is disproportionately high in children.

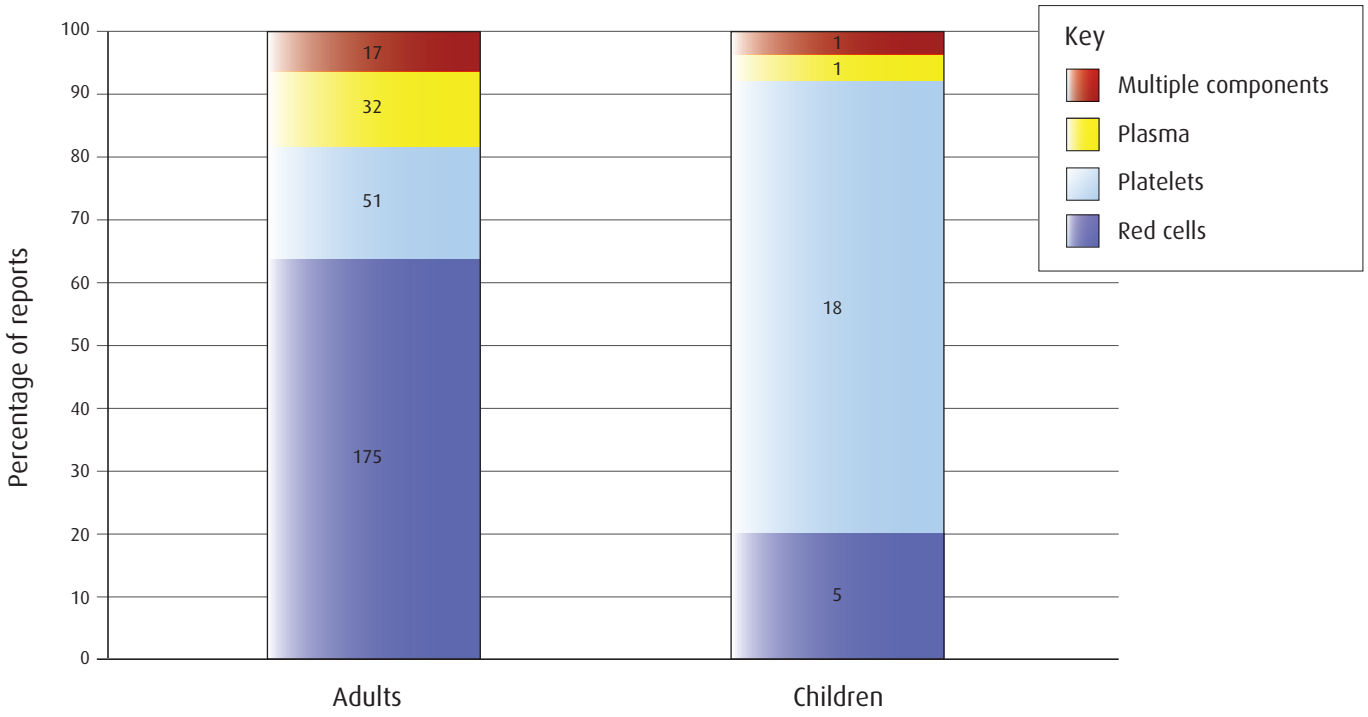
The high percentage of paediatric ATR reports due to platelets (72%) as compared to other components in 2008 contrasts with the paediatric summary data from 1996–2005, where the components implicated were RBC 14/30 (47%), platelets 12/30 (40%) and 4/30 FFP (13%).34 It also contrasts with the relative proportions of reports resulting from the different components in adults (Figure 26), although this difference is partly due to the large number of isolated febrile reactions reported in adults following red cell transfusions.

Table 58
Types of reactions for each component comparing paediatric with adult reports

NB See ATR, Chapter 10 page 90, for total numbers.

Reaction	Red cells		Total platelets		Fresh frozen plasma		Multiple components		Total	
	Adults	<18 yrs	Adults	<18 yrs	Adults	<18 yrs	Adults	<18 yrs	Adults	<18 yrs
Anaphylactic/ anaphylactoid	7		12		8		5		32	
Severe allergic	5	3	3	8	7		2	1	17	12
Hypotensive	5		1		1	1	1		8	1
Febrile with other symptoms or signs	23		4	2	2		1		30	2
Minor allergic	23		19	4	10		2		54	4
Isolated febrile	102	2	8	2	3		6		119	4
Unclassified	10		4	2	1		0		15	2
Total	**175**	**5**	**51**	**18**	**32**	**1**	**17**	**1**	**275**	**25**

Figure 26
Acute transfusion reactions by component type: a comparison between adult and paediatric reports



Types of reactions (as categorised as in the ATR chapter)

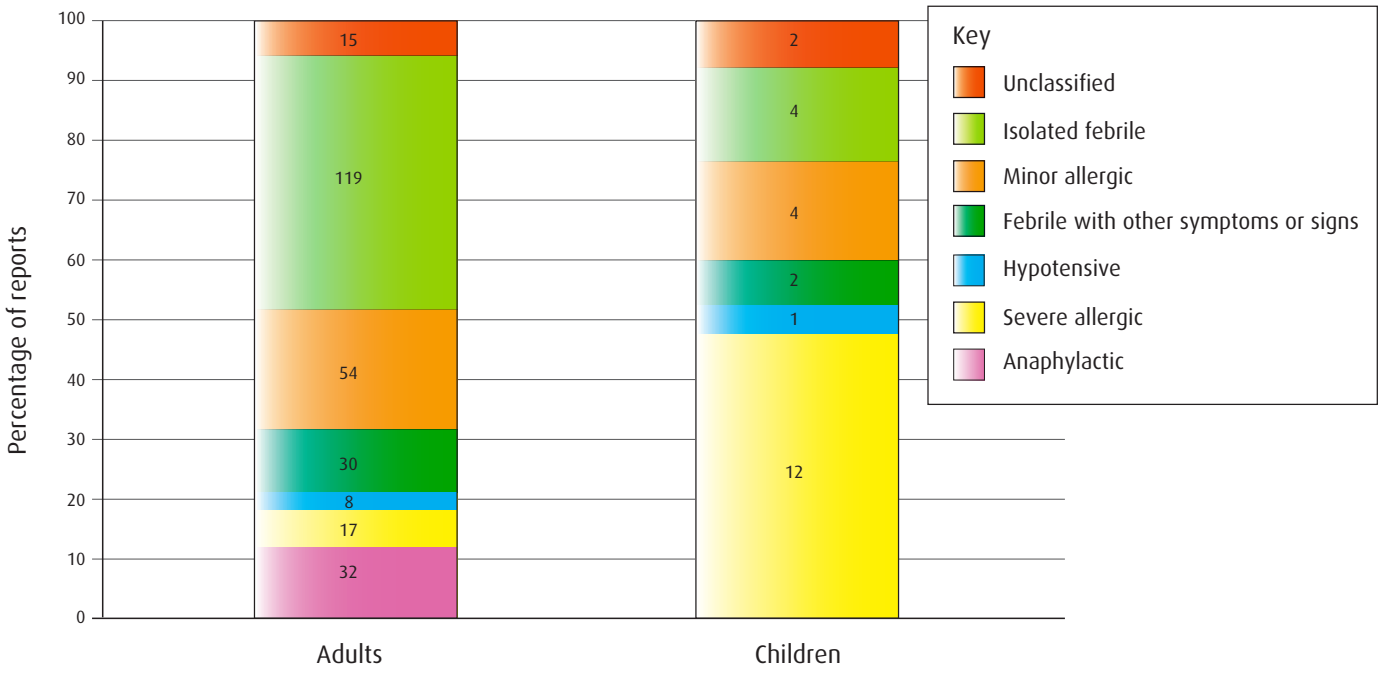
- **Generally** – the reactions reported in children tended to be more severe than those in adults (52% vs. 20% in the severe allergic/anaphylactic/hypotensive categories, see Figure 27). Few isolated febrile transfusion reactions were reported in children. These differences may be due to differences in reporting patterns.
- **RBC** – There were only 5 paediatric reactions reported, but 3 of these were severe allergic reactions, as compared to adults where the majority were isolated febrile or minor allergic reactions: 38% of reports of severe allergic reactions to red cells were in the paediatric age group.
- **Platelets** – 8/18 (44%) paediatric reactions were categorised as severe allergic. Of the total 'severe allergic/anaphylactic' reactions to platelets, 35% were in the paediatric age group.
- **FFP** – only 1 reaction to FFP alone was reported, although it was very severe.

Case 4

Severe hypotension and circulatory collapse in a young child given FFP

An 11-month-old infant with congenital heart disease was transfused FFP and after 10 minutes became hypotensive. The hypotension was initially thought to be due to hypovolaemia so the rate of FFP infusion was increased. However, this resulted in further deterioration and circulatory collapse requiring resuscitation, with opening of the chest and direct cardiac massage. As the patient's symptoms started while the transfusion was in progress and worsened when the rate of infusion was increased this was subsequently believed to have been a transfusion reaction.

Figure 27
Type of acute transfusion reactions – comparison between adult and paediatric reports



Underlying diagnoses

The 1 neonate reported had haemolytic disease of the newborn. Of the rest, 16 were patients with haematological malignancies or solid tumours, 3 had aplastic anaemia, 1 had had a bone marrow transplant, and there was 1 each with a cardiac, vascular, obstetric or trauma-related underlying diagnosis.

HTR

There were 4 paediatric reports of HTR, all of which were from children > 1 yr old (see HTR, Chapter 11). Two patients were group A and haemolysed following transfusion of group O platelets, and in 1 of the cases the platelets were HLA-matched. Both patients had sickle cell disease, and 1 of them developed hyperhaemolysis syndrome after an exchange transfusion pre-adenotonsillectomy. The other 2 patients were being treated for malignancies.

Paediatric reactions were only rarely reported in the HTR category in the past, but some reactions following transfusion of group O platelets to non-group O recipients have previously been included in other sections.

TRALI

There were 2 cases of TRALI, both in 17-year-olds (see TRALI, Chapter 12). There were only 3 paediatric TRALI cases in 2003, and none in 2007. There have been no SHOT reports to date of TRALI cases in infants < 1 yr, which may be either because they don't occur or because they are not recognised. There are very few reports in the literature of TRALI in neonates.[37,38]

Anti-D

There were 4 anti-D errors in patients aged 16–17 years old. One patient had had no antenatal care, perhaps because of circumstances related to her young age, and this may have contributed to delays in recognising that anti-D was needed post delivery.

TTI

There was 1 TTI in a teenager with acute leukaemia who was transfused with a unit of apheresis platelets with *Streptococcus dysgalactiae* and who recovered following antibiotic treatment (see TTI, Chapter 15, for details).

Autologous transfusion

There were 2 paediatric orthopaedic cases where there were difficulties with the cell salvage procedure, which was subsequently abandoned without adverse outcome (see Autologous Transfusions, Chapter 18).

TACO, PTP, TA-GvHD

There were no paediatric reports in any of these categories.

COMMENTARY AND LEARNING POINTS

- There were increased numbers of paediatric reports to SHOT in 2008, but a slight decrease in the overall proportion of reports from children. The majority of reports were still error related but there was a marked increase in the number of ATR reports in those ≥ 1 yr old.
- The transfusion laboratory played a major role in 29/92 paediatric reports (32%), suggesting the need for increased training and awareness of paediatric issues in the laboratory, including component special requirements and the need for crossmatching against the maternal sample where there are historical antibodies. There needs to be particular care in hospitals that use O D positive as well as O D negative paedipaks, and efforts should be made by the UK Blood Services not to alter the supply to hospitals whose policy is to only use O D negative.
- A number of the laboratory errors could have been detected at the bedside check, emphasising the ongoing need for training and awareness of paediatric component requirements among clinical as well as laboratory staff.
- As errors were disproportionately higher for the < 1yr age group all professionals need to pay particular attention when involved with transfusion for these patients. There continue to be reports of adult flying squad blood being given to neonates on obstetric units, and confusion between twins on neonatal units.
- Medical staff need to be aware of groups who need special attention, such as infants for cardiac surgery who may require irradiated components. Transfusion education must cover special requirements in paediatric conditions.
- Patients who are cared for between more than one hospital (e.g. oncology shared care or neonates/cardiac patients transferred to specialist units) are frequently involved in errors relating to special requirements due to lack of formalised communication mechanisms between hospitals. Such mechanisms must be in place involving both clinicians and the laboratory at both sites.
- Inappropriate prescriptions, especially in terms of rate and volume of component, are an ongoing problem that can lead to significant morbidity and mortality, and this needs to be further highlighted during junior doctor training.
- The striking increase in ATR reports in the ≥ 1 yr age group, particularly in platelet reactions, is likely to be due to changes in reporting patterns as there has been no alteration to apheresis platelet components during this period. The relative lack of reports in the infant age group is intriguing and may be a feature of their immature immune system. Further data and analysis of trends in this group will be of interest.
- The ongoing reports of haemolysis following transfusion of group O platelets to non-group O recipients are concerning and recommendations regarding their use for HLA matched recipients may need to be reviewed. These reports also highlight the need to ensure adequate availability of non-group O apheresis platelets (see recommendations in the main ATR chapter).
- The absence of TACO and TRALI reports in neonates and infants is noteworthy. This is part of the general lack of non-error reports including ATR in this age group and needs detailed future studies to identify the reasons. There may be significant lack of recognition or underreporting, but fundamental developmental differences may also contribute to this finding.
- Other adverse outcomes of transfusion such as morbidity associated with venous access are not being captured, and consideration should be given to defining other categories of adverse outcomes associated with transfusion for the neonatal and infant group.

RECOMMENDATIONS

New recommendations from this year

- The trend in increasing ATR cases, in particular in relation to platelets, needs careful monitoring.

  Action: SHOT

- Clinical staff should be encouraged to report all ward-based reactions and events including possible TACO, TRALI and neonatal ATR cases.

  Action: HTTs

Recommendations from previous years

Year first made	Recommendation	Target	Progress
2007	Laboratory BMSs must be aware of special component requirements in patients under 16, and routine checking for additional flags should be carried out based on the date of birth.	**HTT, hospital transfusion laboratories and consultant haematologists with responsibility for transfusion**	This recommendation needs re-emphasis in 2008, and laboratories need sufficient manpower and IT to undertake this. Laboratories must also demand that they are given requests for paediatric transfusions in mL and not units.
2007	Prescribing for paediatric patients should be carried out only by those with appropriate knowledge and expertise in calculating dosage and administration rates for this group.	**HTT and clinical users of blood**	The 2008 report demonstrates a need for continuing training in this area.
2007	Special requirements are more common in paediatric patients, because of the range of congenital and malignant conditions for which they may be hospitalised, and particular care is needed to ensure that documentation, handover, communication and bedside checking are effective and comprehensive.	**HTT and clinical users of blood**	
2003	BCSH guidelines on transfusion of neonates and children should be implemented.	**RCPCH, RCN, staff in paediatric units and transfusion laboratories**	SHOT 'Lessons for paediatric staff' produced 2006. SHOT in obstetrics 2007. NBS Paediatric conference Feb 2007.