24 Paediatric Cases n=169

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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 group: neonates ≤28 days; infants >28 days and <1 year; children ≥1 year to <16 years and young people aged 16 to <18 years.

Abbreviations used in this chapter

ADU	Avoidable, delayed and under/overtransfusion	**IUT**	Intrauterine transfusion
BSH	British Society for Haematology	**LIMS**	Laboratory information management system
CS	Cell salvage	**NEC**	Necrotising enterocolitis
DAT	Direct antiglobulin test	**NM**	Near miss
ENT	Ear, nose and throat	**PICU**	Paediatric intensive care unit
FAHR	Febrile, allergic and hypotensive reactions	**RBRP**	Right blood right patient
FFP	Fresh frozen plasma	**SCD**	Sickle cell disease
Hb	Haemoglobin	**SRNM**	Specific requirements not met
HSCT	Haemopoeitic stem cell transplant	**TACO**	Transfusion-associated circulatory overload
HSE	Handling and storage errors	**TAD**	Transfusion-associated dyspnoea
HTR	Haemolytic transfusion reactions	**TANEC**	Transfusion-associated NEC
HTT	Hospital transfusion team	**TRALI**	Transfusion-related acute lung injury
IBCT	Incorrect blood component transfused	**TTI**	Transfusion-transmitted infection
Ig	Immunoglobulin	**UCT**	Uncommon complications of transfusion
ITP	Immune thrombocytopenic purpura	**WCT**	Wrong component transfused

Key SHOT messages

- Failure of concessionary, rapid laboratory release of components in an emergency e.g., non-neonatal specification for a child <1 year or best-matched red cells for a patient with antibodies can result in significant transfusion delays
- Inappropriate administration of adult O D-negative red cells to neonates in emergency continues to be reported
- Clear communication within teams and between clinical and laboratory areas regarding the patient's transfusion requirements is essential to ensure the timely and appropriate issue of blood components

Recommendations

- Laboratories should have clear policies for rapid, concessionary release of blood components, including roles/responsibilities
- Neonatal/infant specification emergency components should be clearly distinguished from adult components when stored together in satellite refrigerators, with staff training on correct selection in emergency
- Management of paediatric FAHR should be timely and appropriate

Action: Hospital transfusion teams

Introduction

The total number of paediatric cases reported to SHOT in 2023 has increased slightly compared to 2022 (169 vs 151, Figure 24.1). Paediatric cases account for 169/2154 (7.8%) of total reports if NM and RBRP are excluded and 274/3833 (7.1%) if NM and RBRP are included. Neonates and infants represent 1/3 of paediatric cases, 56/169 (33.1%).

Overrepresentation of paediatric reports is seen once again in FAHR, ADU (delay and overtransfusion) and IBCT-WCT. However, this year, paediatric reports are also overrepresented in HSE and in UCT (Figure 24.2).

Clinical errors remain slightly more common than laboratory errors with 63/120 clinical (52.5%) versus 57/120 (47.5%). Overall, laboratory errors have increased in paediatric as well as in adult reports, likely reflecting pressure on laboratory working. The prominence of clinical errors in ADU and HSE reflects the additional complexities of prescribing and transfusing in neonates and children.

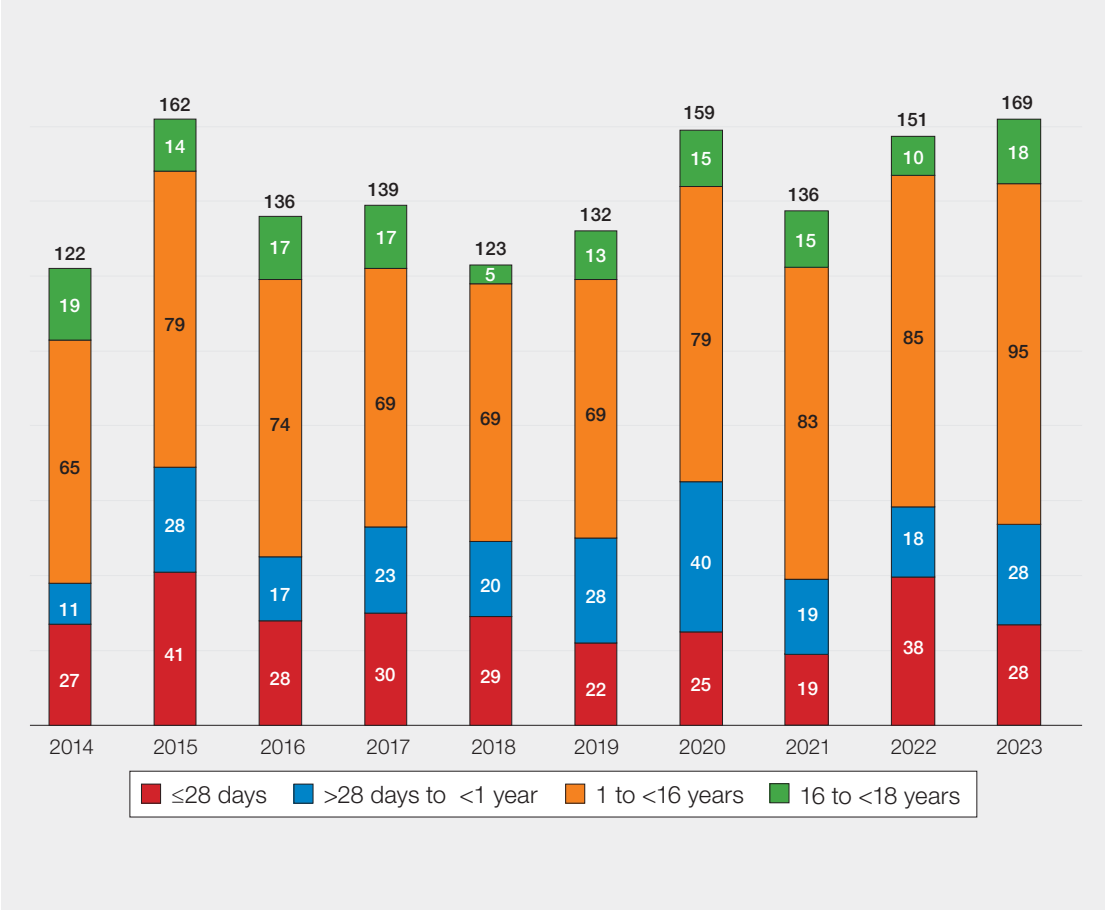
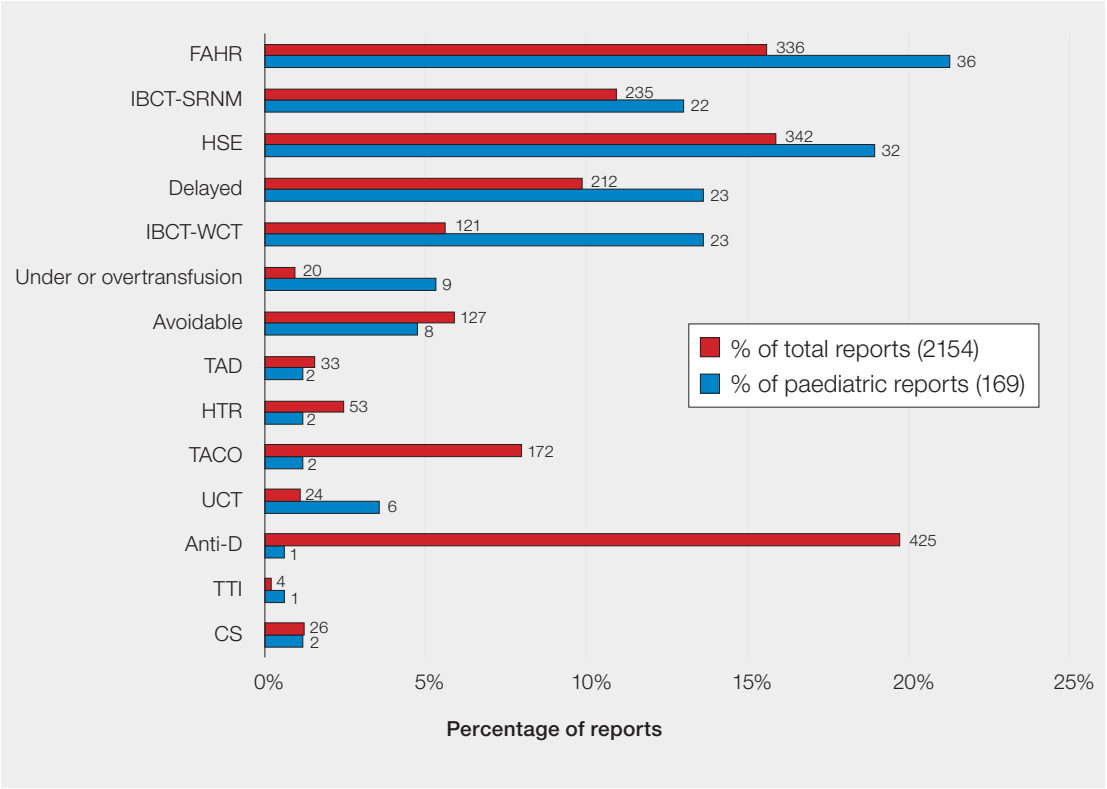


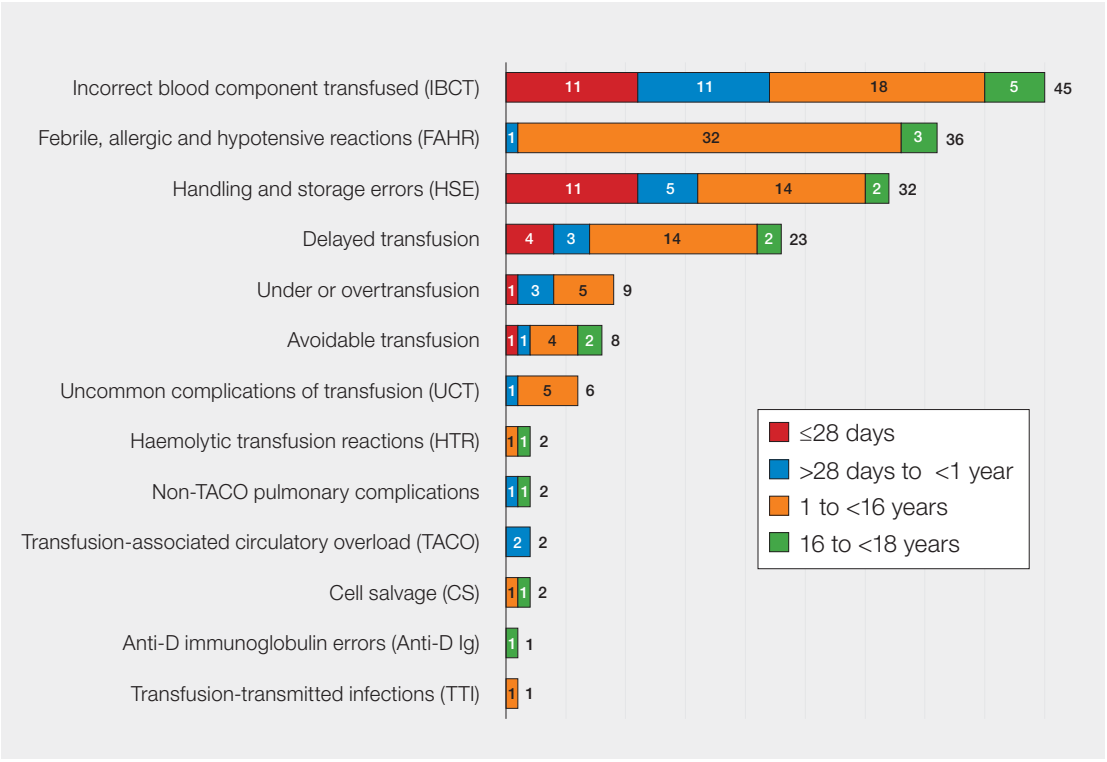
Figure 24.1: Trends in paediatric reports 2014-2023

Figure 24.2: Percentages of paediatric and total reports in each category in 2023 (n=169)



CS=cell salvage; FAHR=febrile, allergic and hypotensive reactions; HSE=handling and storage errors; HTR=haemolytic transfusion reactions; IBCT-SRNM=incorrect blood component transfused-specific requirements not met; IBCT-WCT=IBCT-wrong component transfused; TACO=transfusion-associated circulatory overload; TAD=transfusion-associated dyspnoea; TRALI=transfusion-related acute lung injury; TTI=transfusion-transmitted infection; UCT=uncommon complications of transfusion

Figure 24.3: Summary of paediatric cases by category and age in 2023 (n=169)



Deaths related to transfusion n=1

There was one death possibly related to transfusion (imputability 1) reported in 2023. This was a case of possible TANEC, summarised in Case 24.1 and discussed in Chapter 20, Uncommon Complications of Transfusion (UCT).

Case 24.1: Death due to bowel perforation within 24 hours of red cell transfusion

An extreme preterm neonate (a month old) received a red cell transfusion for anaemia. Eight hours later the neonate developed significant deterioration including a distended abdomen and required reintubation. Abdominal X-ray was suggestive of NEC. The neonate subsequently developed bowel perforation and metabolic acidosis and died.

Major morbidity n=27

There were 27 cases of major morbidity. FAHR remains the largest category with 21/27 cases. The remaining cases were 2 delayed transfusions, 1 overtransfusion, 1 pulmonary non-TACO, 1 TTI and 1 HTR.

Error-related reports n=120

There was a significant increase in paediatric error reports in 2023 (120 versus 101 in 2022, 83 in 2021).

Incorrect blood component transfused (IBCT) n=45

The total number of IBCT reports increased in 2023, particularly for laboratory errors (n=33), in both IBCT subcategories (IBCT-WCT and IBCT-SRNM).

IBCT-wrong component transfused (WCT) n=23

IBCT-WCT clinical errors n=8

Adult specification component to infant or neonate n=3

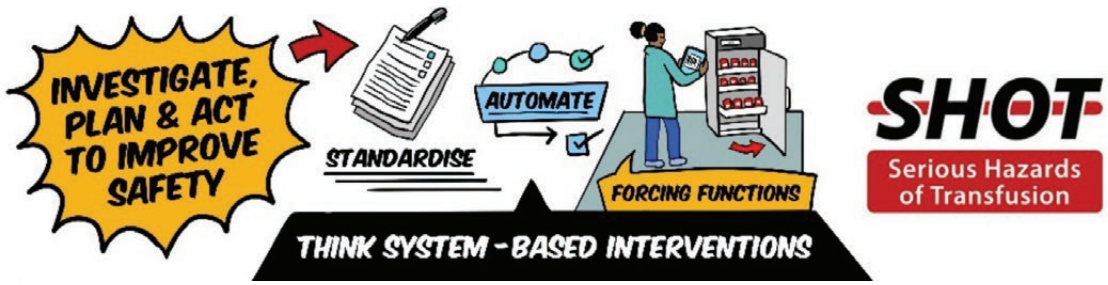
There continue to be reports of neonates receiving adult emergency O D-negative red cells.

Case 24.2: Adult O D-negative red cells given to a neonate in error when neonatal red cells were available

A bleeding neonate required an emergency red cell transfusion. The laboratory instructed the clinical team use the 'emergency paedipack' from the satellite refrigerator. An adult pack was accidentally selected and transfused to the neonate.

Learning point

- SHOT receives recurring reports of incorrect administration of adult specification red cells to neonates in an emergency. Hospitals should ensure that red cells suitable for neonates are clearly distinguished from adult components when stored in the same refrigerator and that clinical staff collecting blood understand the different component types



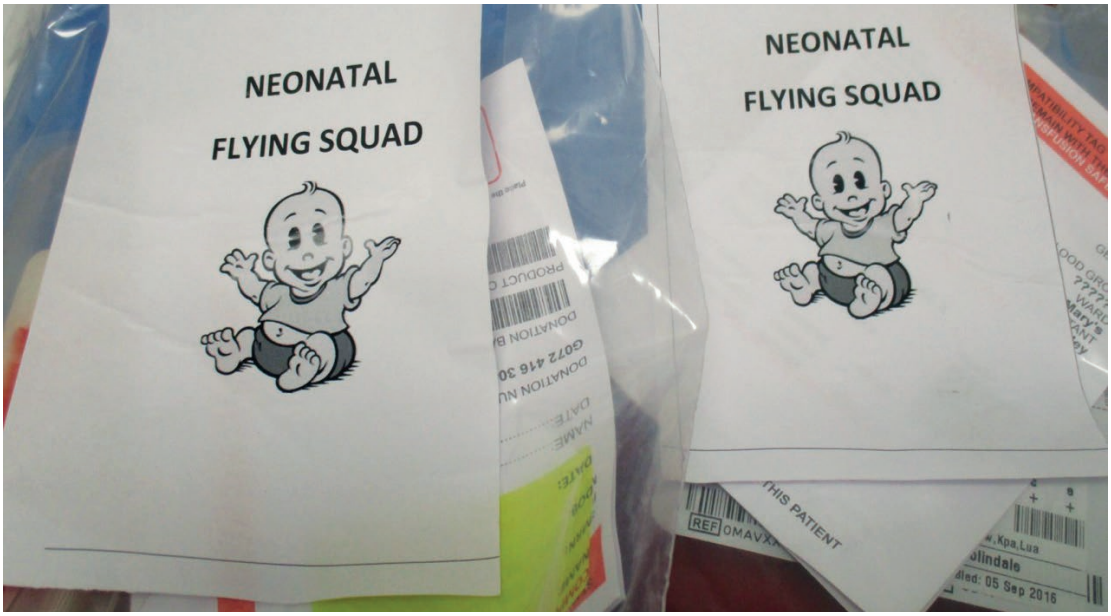


Figure 24.4: Example of how to distinguish neonatal from adult components in a satellite refrigerator

With permission from Rachel Moss, transfusion practitioner at Great Ormond Street Hospital

Incorrect component to HSCT recipient n=4

In 4 cases, a HSCT patient received red cells of the incorrect ABO blood group due to failure of communication between the clinical and laboratory teams or to follow policy.

Other n=1

D-positive red cells were transfused to young female child in trauma/major haemorrhage pre-hospital setting.

IBCT-WCT laboratory errors n=15

Adult specification component to infant or neonate n=4

All 4 were infants who received standard adult red cells rather than neonatal/infant specification large volume red cells. One was transfused during surgery with aliquots from a standard adult unit. The error was discovered postoperatively when the parent found the remains of the unit amongst the child's bag of washing.

Incorrect component to HSCT recipient n=4

The incorrect ABO group component was issued for 4 post-HSCT patients despite clear LIMS instructions.

D-positive red cells to D-negative recipient n=4

A female neonate received a D-positive red cell unit because the theatre refrigerator had been incorrectly stocked with D-positive neonatal emergency blood. Errors in D grouping impacting transfusions occurred in 2 cases.

The final case was a male teenager with major haemorrhage who received eight units of group O D-positive red cells pre-hospital. This was not in line with current BSH guidelines (Milkins, et al., 2013; New, et al., 2016; New, et al., 2020).

Other n=3

Case 24.3: Preterm neonate erroneously assigned as blood group O

The laboratory assigned a preterm neonate as group O and issued group O FFP. It was subsequently determined that the neonate had been grouped as A at birth in a different hospital where they were transfused with emergency blood group O red cells. Of note, the laboratory should have issued group AB FFP as only one group result was on record.

Learning point

- If a neonate is transferred between hospitals, any history of prior transfusion must be communicated to the receiving transfusion laboratory. Caution is required when interpreting neonatal groups, as prior transfusion may result in mixed field or group misinterpretation

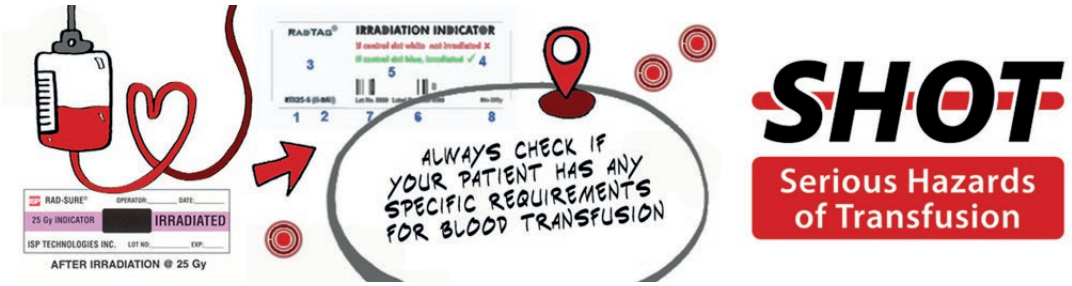
Another neonate received inappropriate transfusion of group O cryoprecipitate with only one grouping sample in the laboratory. The final case was a laboratory mix-up between two packs of apheresis platelets.

IBCT-specific requirements not met (SRNM) n=22

There were 18 laboratory and 4 clinical errors where specific transfusion requirements were not met in paediatric patients. These are detailed in Table 24.1.

Table 24.1: Paediatric SRNM errors in 2023 (n=22)

Type of SRNM error	Number of cases	Detail of errors
Inappropriate electronic issue	6	One teenager with SCD (previous antibodies). Three neonates: 1 with positive antibody screen, 1 without maternal antibody screen results and 1 with a positive DAT. Two children were post HSCT
Failure to request irradiated components	5	4 clinical errors: 1 neonate with prior IUT, 1 young child with DiGeorge syndrome, 1 pre HSCT, 1 had received fludarabine 1 laboratory error due to due to failure to check maternal transfusion history for a neonate with a prior IUT
Incomplete testing	5	Two neonates with incomplete testing where maternal antibody status was unknown; 3 infants over 4 months with no antibody screen performed
Failure to provide phenotyped components	5	One neonate with a maternal antibody and 4 children with SCD
Failure to provide HLA-matched components	1	Routine HLA-matched platelets not provided



Avoidable, delayed, under or overtransfusion n=40

Avoidable transfusions n=8

There were 2 reports of non-bleeding older children with ITP being transfused with platelets.

Case 24.4: Platelet transfusion given to a non-bleeding teenager with acute ITP

A teenager presented with acute ITP. The platelet count was 14x10^9/L, on repeat 10x10^9/L. A platelet transfusion was requested by the ENT team and administered. The patient had no bleeding.

Learning point

- Platelet transfusion in ITP is only indicated for serious bleeding or prior to a procedure when other treatment has failed or if urgent (Estcourt, et al., 2017). The requirement for transfusion should be discussed with a haematologist prior to administering platelets

In 2 cases, unnecessary platelet transfusions were given due to inaccurate results (platelet clumping). One case of failure of communication led to repeat transfusion, 2 were avoidable use of group O

D-negative red cells, and 1 child inappropriately received two units of platelets rather than one prior to central line removal.

Delayed transfusion n=23

Delays in transfusion were again prominent within paediatrics; 15 cases were primarily due to laboratory errors and 8 were clinical.

Laboratory errors n=15

Of the 15 laboratory cases, most appeared unrelated to being paediatric. There were 8 cases which included delays in ordering from/provision by Blood Services; 1 case involved a failure to scan platelets out of an agitator causing confusion and transfusion delay, and 2 cases resulted from grouping issues.

There was failure to communicate the timescale for crossmatch in the presence of red cell alloantibodies in a child with a severe dermatological disorder, resulting in delay due to loss of venous access. In another case, a teenager with leukaemia had a two-unit red cell transfusion requested but only a single unit issued.

Finally, there were delays in decision to issue components under concessionary release in urgent situations for 2 patients, discussed in Cases 24.5 and 24.6.

Case 24.5: Delay in concessionary release of adult specification platelets for a neonate with significant bleeding

Emergency platelet transfusion was requested for a severely thrombocytopenic neonate with liver failure and both rectal and intracranial bleeding. Neonatal/infant specification platelets were not available on site. The clinical team asked for standard adult specification platelets but there was a 2-hour delay in authorising their release due to difficulty in contacting the haematology medical team and the laboratory's inability to authorise emergency release.

Case 24.6: Delay in red cell transfusion for critically unwell teenager with SCD due to failure to issue red cells urgently under concessionary release

A teenager with SCD and multiple red cell antibodies was on the point of cardiac arrest due to rapidly progressive anaemia (from 97g/L to 45g/L), hypoxia, and acidosis. Whilst awaiting frozen thawed red cells, the Blood Service consultant on call advised transfusing ABO, Rh matched, K-negative red cells given the urgency. There was a 3-hour delay in issuing red cells. The pre-transfusion Hb was 26g/L immediately prior to transfusion. The delay contributed to major morbidity in this patient.

Learning points

- For concessionary release of standard adult components to neonates and infants, laboratories are recommended to have pre-agreed hierarchies in place (New, et al., 2016; New, et al., 2020)
- Clear communication between clinicians and laboratory staff is required in urgent situations to ensure timely issue of blood components under concessionary release
- Transfusion laboratories require access to adequate senior support at all times

Clinical errors n=8

In one case, there was a request for a neonate where the maternal antibody was recorded as an anti-'e' but was actually anti-'E'. In another case, an infant received a red cell transfusion with no confirmatory group or consent. Three cases involved failure to order the blood component, to send a group and screen sample pre-surgery, or to communicate with portering staff. Others involved expired staff training, and communication problems in a major haemorrhage.

A teenager with SCD and positive antibody screen had an emergency red cell exchange delayed by 24-hours and is discussed in Case 24.7.

Case 24.7: Delay in provision of appropriate red cells for a teenager with SCD and red cell antibodies

A teenager with sickle chest syndrome required emergency red cell exchange transfusion. There was a 24-hour delay due to poor communication between laboratory and clinical staff regarding degree of urgency, and to failure to send crossmatch samples of sufficient volume to allow required antibody testing. The patient recovered fully with no adverse impact from the delay.

Learning point

- Red cell antibodies can cause delay in obtaining compatible red cell units; additional samples are often required, and good communication is vital to ensure timely provision of blood components

Undertransfusion n=1

A child was issued with a neonatal split red cell pack but required a larger volume.

Overtransfusion n=8

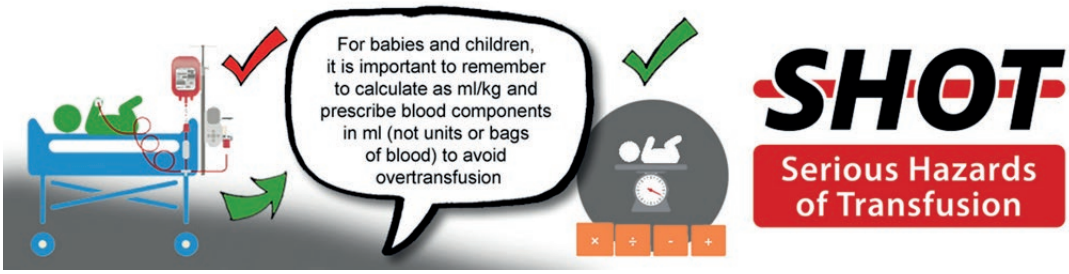
All 8 cases were clinical errors, 6 related to prescribing. In 1, a neonate was prescribed 30mL/kg of red cells in error. Another involved failure to use the prescribing formula. For 1 child with a haematinic deficiency, an inappropriately high Hb target was chosen resulting in a >30mL/kg transfusion (and furosemide requirement). A lower threshold, smaller volume transfusion followed by haematinic replacement would have been appropriate. Two cases involved prescription of a full adult unit to a small recipient, 1 was an adult-sized platelet unit to a 6.5kg infant (40mL/kg) and the other was a full adult red cell unit to a young child.

A significant overtransfusion occurred in a vulnerable preterm neonate described in Case 24.8.

Case 24.8: Overtransfusion in a preterm neonate due to illegible prescription

An extremely pre-term infant (birth weight 0.5kg) with NEC was prescribed platelets. The prescription should have been 7.5mL but was misread as 75mL. The neonate received 43mL (83mL/kg) before this was noticed and subsequently was hypertensive. The reporter commented that electronic prescribing had not been implemented in paediatrics due to complexities.

There were 2 administration errors: a full unit and a part of a second were administered to a child; an infant received excess platelets due to confusion around a pump attached to a three-way tap.



Cell salvage n=2

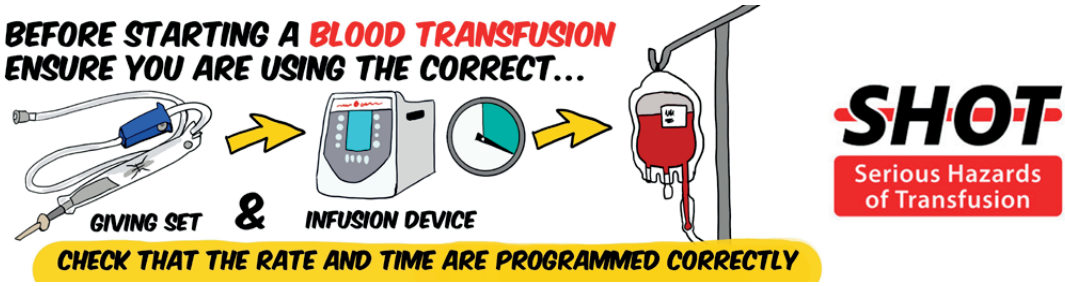
Both cases were in older children (1 a teenager). One was a leak in a cell salvage set, the 2nd was the presence of dark 'spots' in the red cells.

Handling and storage errors (HSE) n=32

There was a striking increase in 2023 (22 in 2022). Again, there were more clinical (26) than laboratory (6) errors.

Table 24.2: Paediatric HSE errors in 2023 (n=32)

Type of HSE error	Number of cases	Detail of errors
Pump-related errors	15	12 pump programming errors 3 were due to a faulty pump
Giving set or infusion errors	5	4 errors involved giving sets 1 involved incompatible fluids
Cold chain errors	4	In 2 cases, neonates were transferred between hospitals with accompanying red cell units. These were transported under suboptimal conditions and without the awareness of transfusion laboratory staff
Inappropriate return to stock/reservation period exceeded	3	
Excessive time to transfuse	2	These transfusions took place over 5 hours and 40-45 minutes (an infant and a teenager)
Other	3	2 unusual cases of contamination of red cells for neonatal/ infant transfusions via needlestick injuries to the nurses drawing up blood from the units using a needle rather than a conventional giving set.



Anti-D immunoglobulin (Ig) n=1

There was an accidental late administration of anti-D Ig for a teenage patient following delivery of a D-positive baby.

Transfusion-related reactions n=49

Febrile, allergic, and hypotensive reactions (FAHR) n=36

The number and proportion of paediatric platelet FAHR were lower this year than in previous years, 19/36 (52.8%). In the preceding 5 years (2018-22) they comprised 66% of paediatric FAHR (Figure 24.5 and 24.6).

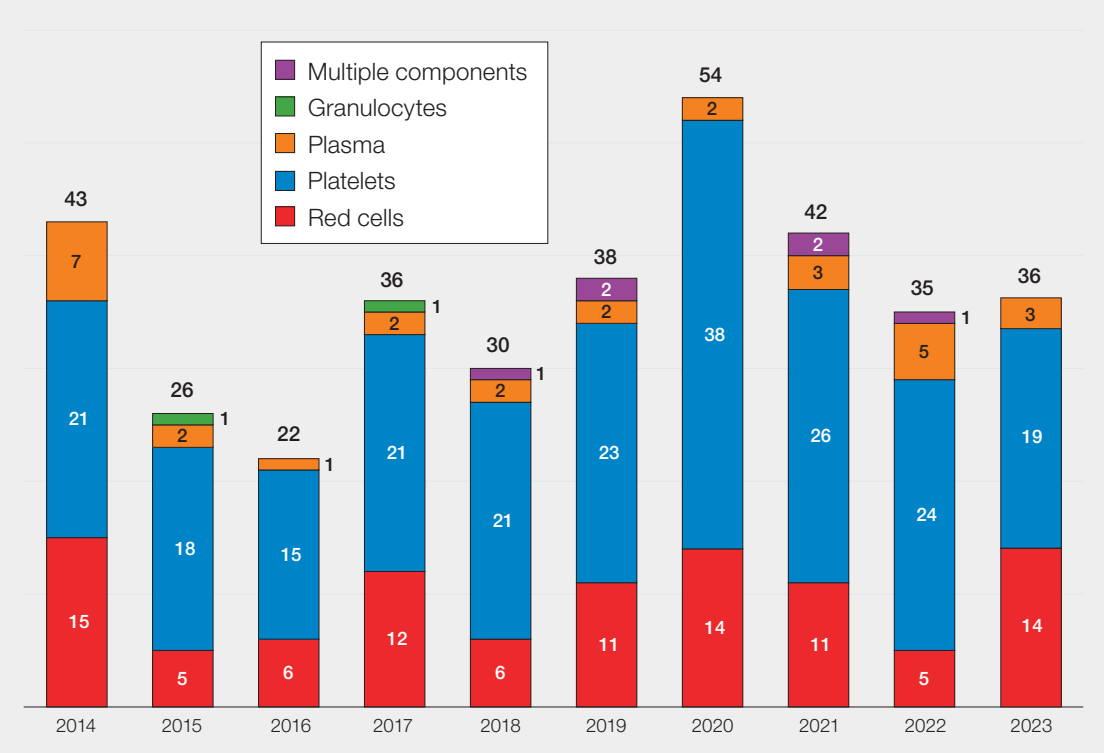


Figure 24.5: Summary of paediatric FAHR reports by component type from 2014-2023

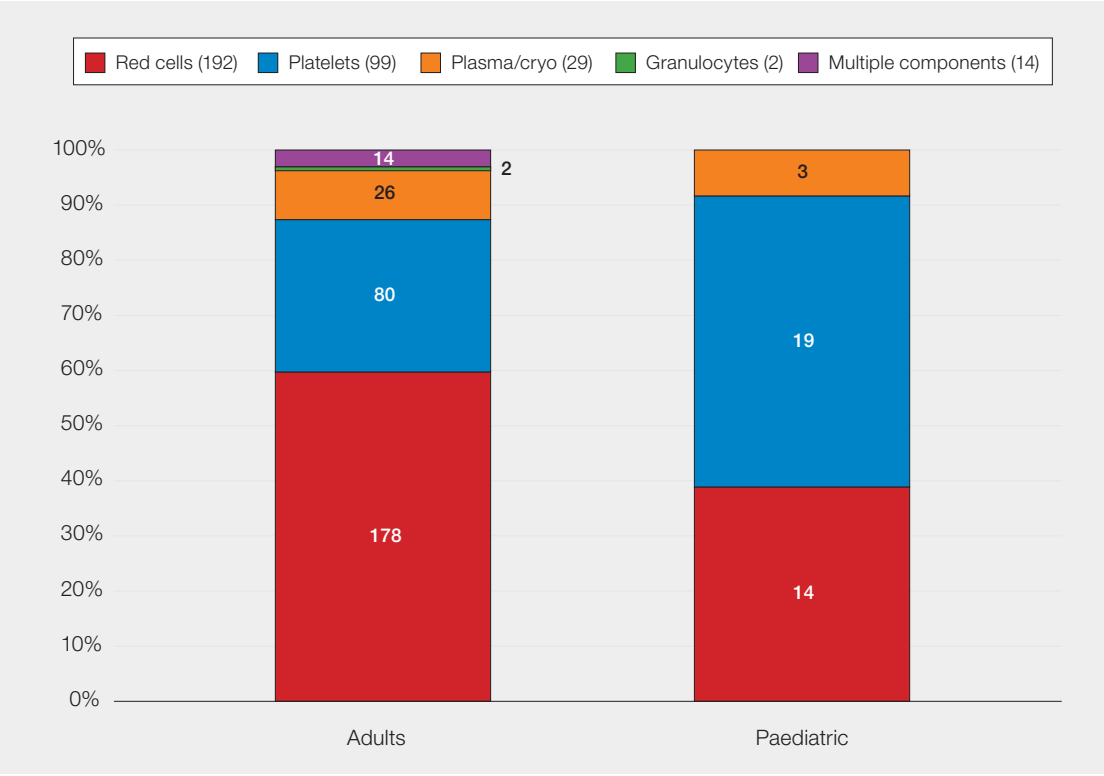


Figure 24.6: Paediatric febrile, allergic, and hypotensive reports (FAHR) in 2023 (n=36)

a: Comparison of proportions of adult and paediatric

Figure 24.6: Paediatric febrile, allergic, and hypotensive reports (FAHR) in 2023 (n=36)

b: Percentages of reaction types by paediatric FAHR related to different component types for paediatric reports

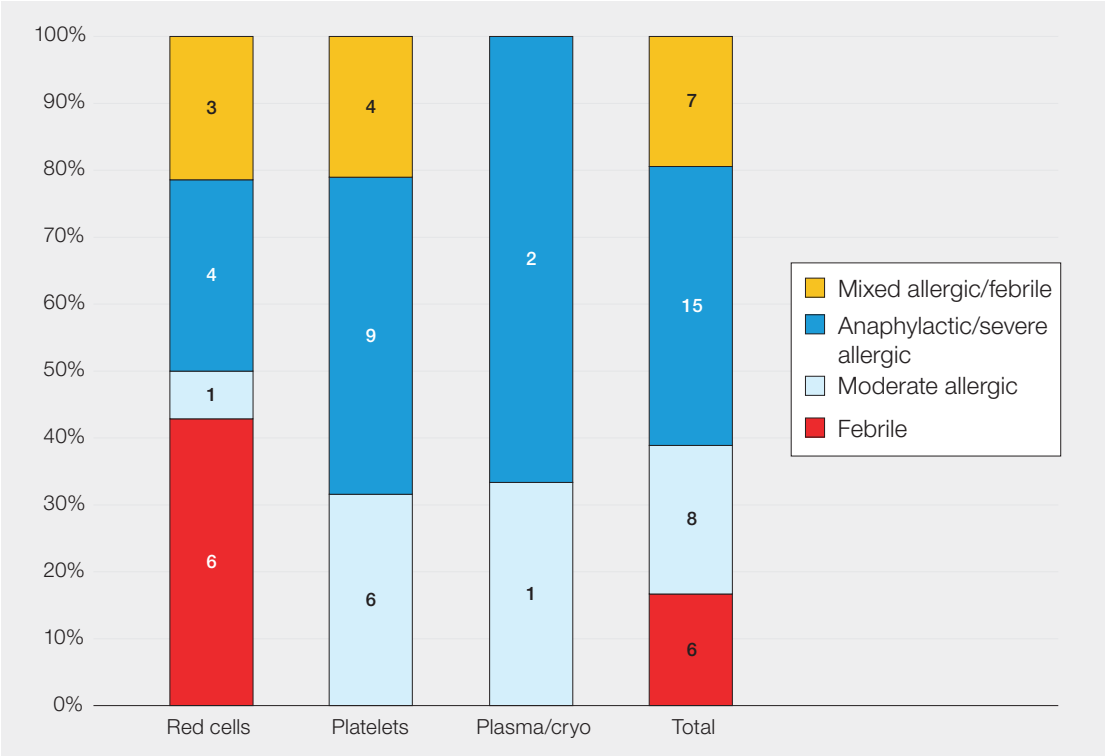


Figure 24.6b shows that 23/36 (63.9%) FAHR were allergic, 6/36 (16.7%) febrile and 7/36 (19.4%) mixed.

Of note, 2 red cell FAHR cases reported in 2023 were part of a cluster of 5 unusual reactions from a single hospital (see example discussed in Case 24.9), the other 3 are discussed in Chapter 20, Uncommon Complications of Transfusion (UCT).

Case 24.9: Allergic reaction to red cell component in multiply transfused patient

A child receiving regular red cell transfusions for a haemoglobinopathy, developed coughing followed by drowsiness after only 4mL of red cells. There was increased work of breathing and prolonged expiratory phase, with a drop in blood pressure. The child received intravenous antihistamine and adrenaline, then further adrenaline with hydrocortisone was administered when the reaction was prolonged. The child recovered and was subsequently given washed red cells.

Learning points

- The management of FAHR is summarised in the BSH guidelines (Soutar, et al., 2023)
- The UK Resuscitation Council guideline 2021, emphasised use of intramuscular adrenaline to treat anaphylaxis, repeated after 5 minutes if required (Working Group of Resuscitation Council UK, 2021)

Haemolytic transfusion reactions (HTR) n=2

One case was a delayed HTR in a teenager transfused for sickle chest crisis, subsequently found to have developed an anti-U.

The second case involved hyperhaemolysis which resulted in PICU admission in a child with SCD. No new alloantibodies were detected.

Pulmonary complications of transfusion in neonates and children n=4

Transfusion-associated circulatory overload (TACO) n=2

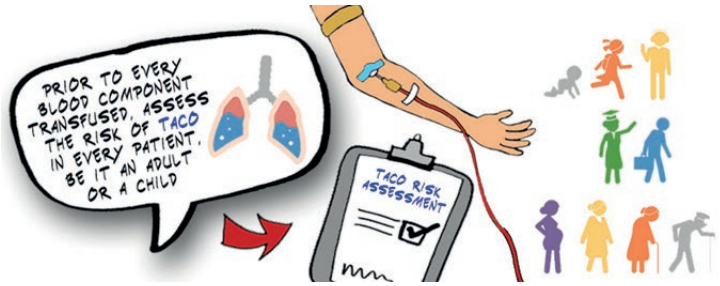
Both cases were in preterm infants less than 4 months old with chronic lung disease. One had low albumin and developed an increased respiratory rate and oxygen requirement 1 hour after the transfusion commenced (received approximately 6mL/kg). They responded to furosemide. The second had a patent ductus arteriosus and developed signs of fluid overload post transfusion (15mL/kg).

A separate TACO risk assessment does not exist for paediatrics, however many of the same risk factors apply. Caution is needed for prescribing transfusions in young children to ensure correct volume is administered. As in these 2 cases, TACO can still occur in at-risk infants when transfused with standard accepted volumes. Commonly used neonatal red cell top-up transfusion volumes (15mL/kg, (New, et al., 2016; New, et al., 2020)) are significantly higher in relation to body weight than the one red cell unit recommended for adults (NICE, 2015).

Non-TACO n=2

Following HSCT transplant, a teenager with SCD developed significant respiratory distress within 2 hours after a platelet transfusion, requiring intensive care admission. Investigations for TRALI were negative.

In the second case an infant with a congenital diaphragmatic hernia and pulmonary hypertension desaturated during a red cell transfusion. The child had been unwell since delivery and had developed sepsis. The infant fully recovered from this event.



SHOT
Serious Hazards of Transfusion

Transfusion-transmitted infections (TTI) n=1

There was 1 confirmed case of transfusion-transmitted malaria in a young child with thalassaemia in 2023. This is described in Chapter 21, Transfusion-Transmitted Infections (TTI), Case 21.5.

Uncommon complications of transfusion (UCT) n=6

There was 1 case of possible TANEC, resulting in the death of the neonate (discussed in Case 24.1 and in Chapter 20, Uncommon Complications of Transfusion (UCT)).

One case involved hypertension following transfusion in a sick young child with acute leukaemia.

In another case there was a report of possible transfusion-associated hyperkalaemia (6.7mmol/L) in a young child (10.4kg) undergoing cardiac surgery on bypass. The red cell unit was 35 days old. There are no recommendations restricting age of red cells for children in this situation other than for large volume infant transfusions. However, it is recommended that potassium concentrations should be checked in the bypass fluid before connecting to the patient (New, et al., 2016; New, et al., 2020).

The other 3 cases were part of an unusual cluster of 5 in multiply transfused patients; 2 met FAHR criteria and are discussed earlier in the chapter, but the other 3 were atypical. The 5 reactions had common features including rapid onset of coughing, chest tightness, drowsiness (4/5) wheeze (2/5) after small red cell volumes were transfused. Four received adrenaline. Despite detailed review and investigation,

no common cause for the reactions were identified. These cases highlight the importance of local review of transfusion reactions: the co-location of cases with similar features would not have been detected by SHOT.

Learning point

- Detection of this cluster of reports highlights the key role of transfusion practitioners and other members of the HTT in reviewing and trending their local transfusion errors and adverse reactions. There is an EU directive stating that data must be routinely analysed 'to identify quality problems that may require corrective action or to identify unfavourable trends that may require preventive action' (European Committee (Partial Agreement) on Blood Transfusion (CD-P-TS), 2023)

Paediatric error reports with no harm n=105

The numbers of cases of no harm/near miss are summarised below. See individual chapters for details.

RBRP n=11

Near miss cases n=27

Near miss-WBIT n=67

Conclusions

Key themes emerging from the paediatric reports submitted to SHOT in recent years, and actions needed to improve transfusion safety are summarised below:

- Paediatric teams should have access to local paediatric transfusion policies which must be aligned with national guidelines
- Induction training of paediatric staff should include specific requirements and weight-based prescribing to prevent errors in calculation of blood transfusion volumes and prescribing specific requirements for transfusion
- Gaps in staff knowledge regarding significance of test results and interpretation should be addressed and staff should be aware when to seek specialist advice
- Effective, timely and clear communication between clinical teams and transfusion laboratories is vital, especially for children undergoing HSCT and patients with haemoglobinopathies as transfusion requirements can be complex
- When transferring patients between hospitals, careful coordination and communication between clinical and laboratory teams is essential to ensure safe transfusions
- Paediatricians and neonatologists should be able to recognise transfusion reactions that can occur in various clinical settings and initiate appropriate management
- Members of the HTT should review and trend their local transfusion errors and adverse reactions in order to promptly detect any clustering of cases and investigate appropriately

Recommended resources

SHOT Bite No 4: Lessons in Paediatrics (including neonates)
SHOT Bite No. 5: FAHR (2021)
https://www.shotuk.org/resources/current-resources/shot-bites/

Webinar on accurate and complete patient identification for safe transfusion in paediatrics
https://www.shotuk.org/resources/current-resources/webinars/

Paediatric SHOT
https://www.shotuk.org/resources/current-resources/videos/

Paediatric Cases Cumulative Data
https://www.shotuk.org/resources/current-resources/data-drawers/paediatric-cases-cumulative-data/

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