Headline Data: Deaths, Major Morbidity and ABO-Incompatible Transfusions

3

Authors: Shruthi Narayan and Debbi Poles

Key SHOT messages

- **Transfusion-associated circulatory overload (TACO) and transfusion delays** are the most common causes of transfusion-related deaths in the UK in 2020 and accounted for 30/39 deaths (76.9%). Some of these could have been prevented and measures must be taken to address these. Vigilant staff, effective communication and collaboration among staff and use of the TACO checklist are all vital in reducing these incidents
- **Investigations of all deaths and learning from serious events.** Incident investigations should be standard in all cases where transfusion may have contributed to the death of a patient, as it provides an opportunity for learning and improvement. An effective investigation includes review of system design and human factors revealing all contributory factors and incidental findings that can then be addressed in the corrective and preventive actions (CAPA). A SHOT guidance tool for TACO incident investigation is now available (see recommended resources)
- **Near miss** events continue to account for most reports submitted to SHOT (1130/3214, 35.2%). Reporting and investigating near misses helps identify and control risks before actual harm results, providing valuable opportunities to improve transfusion safety. Investigations into the cause of near misses will enable a more proactive approach to safety. Potential system failures and hazards can be identified and corrected before harm or injury occurs

Abbreviations used in this chapter

ABOi	ABO-incompatible	**NM**	Near miss
CAPA	Corrective and preventive action	**PAS**	Platelet additive solution
FAHR	Febrile, allergic and hypotensive reactions	**PCC**	Prothrombin complex concentrate
FFP	Fresh frozen plasma	**RCA**	Root cause analysis
Hb	Haemoglobin	**SRNM**	Specific requirements not met
HSCT	Haemopoietic stem cell transplant	**TACO**	Transfusion-associated circulatory overload
IBCT	Incorrect blood component transfused	**UK**	United Kingdom
LIMS	Laboratory information management system	**WBIT**	Wrong blood in tube
NHS	National Health Service	**WCT**	Wrong component transfused

The recommendation from last year remains pertinent:

Recommendation

- National Health Service (NHS) Trusts/Health Boards must use intelligence from all patient safety data including national haemovigilance data to inform changes in healthcare systems, policies, and practices to embed the lessons learnt and truly improve patient safety

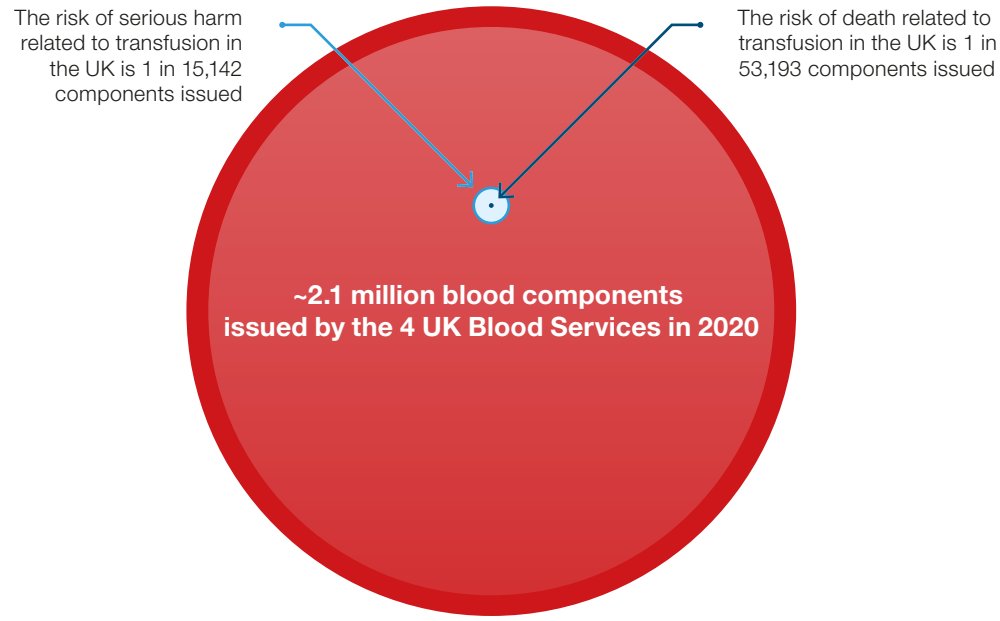
Action: Hospital chief executives and medical directors, National Blood Transfusion Committee (or the equivalent for the devolved countries), hospital transfusion teams

Introduction

Haemovigilance reporting and learning from reports submitted contribute to improving patient safety. These reports provide a mechanism to identify risks so that all healthcare organisations can implement interventions to reduce these risks. Data from SHOT provide valuable information to identify hazards and worthwhile learning opportunities. Data from 2020 show that while transfusions are generally safe in the UK, there are definite areas for concern where actions are urgently needed to improve transfusion safety, and these are elaborated further in this chapter and throughout the Annual SHOT Report.

The risk of death related to transfusion in the UK is 1 in 53,193 components issued and the risk of serious harm is 1 in 15,142 components issued (Figure 3.1).

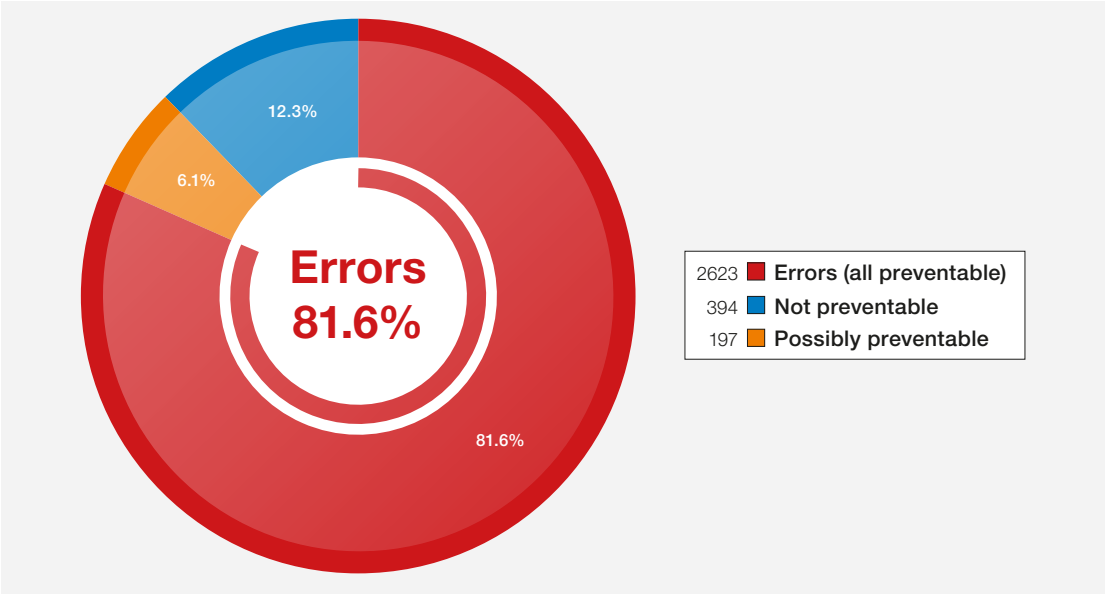
Figure 3.1: Risk of death and serious harm relating to transfusions in the UK in 2020



Note: This is a representative image and not accurate to scale

Serious adverse reactions and events related to transfusion are reported to SHOT and errors continue to account for most of the reports 2623/3214 (81.6%) (Figure 3.2).

Figure 3.2: Errors account for most reports: 2623/3214



Trends in the last few years indicate that while there is a slight downward trend, errors continue (figure 3.3). This means that sustainable systemic improvements to prevent these transfusion errors may not have been fully implemented. Data shows some improvements are being made and every effort must be made in both clinical areas and transfusion laboratories to reduce errors further.

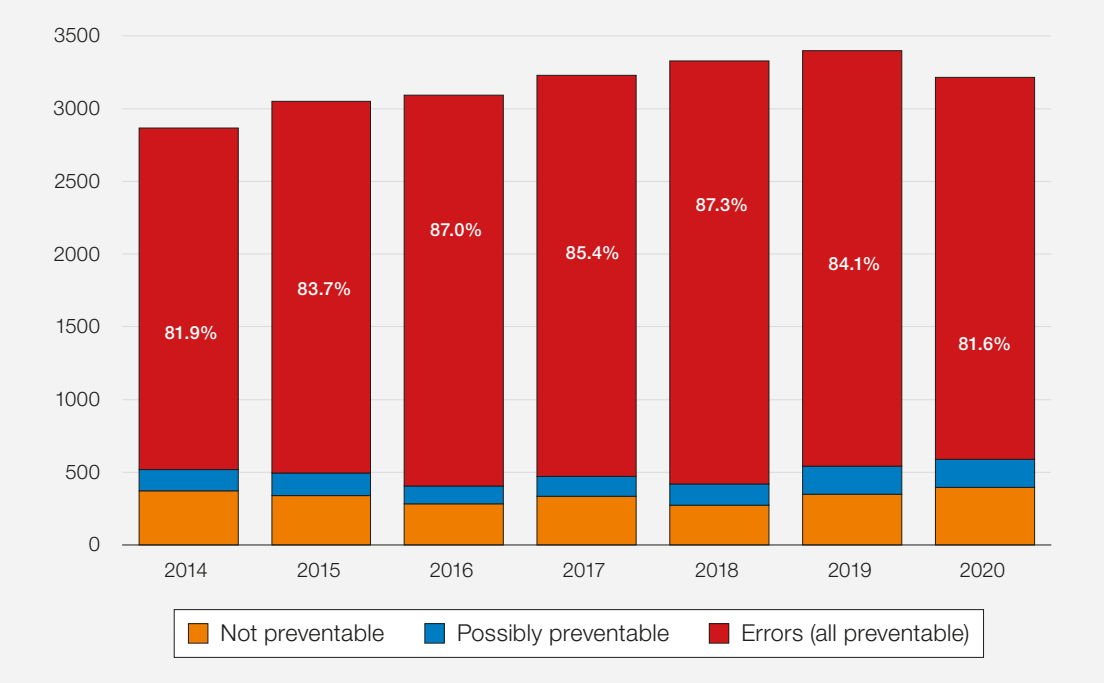


Figure 3.3: Errors as a percentage of total reports 2014-2020

Deaths n=39

There has been a steep increase (17 deaths were reported in 2019) in the number of deaths reported in 2020 related to transfusions. This number includes deaths definitely, probably and possibly (imputability 3, 2, and 1 respectively) related to the transfusion.

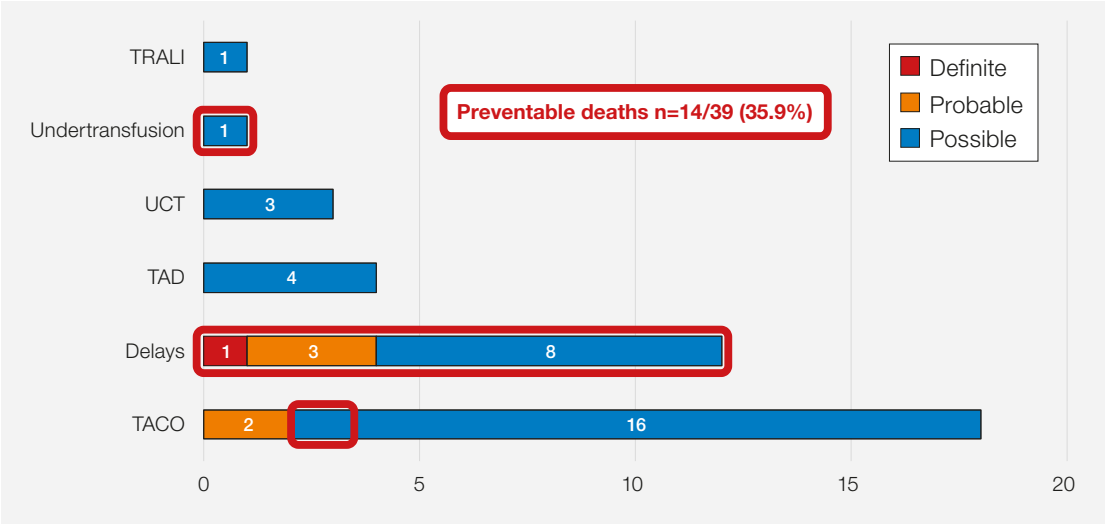
All serious reactions reported to SHOT are assessed for imputability i.e. the relationship of the blood transfusion to the reaction. The imputability criteria are detailed in the table below:

Table 3.1: Grading of imputability

Imputability		
N/A	Not assessable	When there is insufficient data for imputability assessment
0	Excluded or unlikely	When there is conclusive evidence beyond reasonable doubt for attributing the adverse reaction to causes other than the blood or blood components or where the evidence is clearly in favour of alternative causes
1	Possible	When the evidence is indeterminate for attributing the adverse reaction either to the blood or blood component or where there may be alternative causes
2	Likely/probable	When the evidence is clearly in favour of attributing the adverse reactions to the blood or blood component
3	Certain	When there is conclusive evidence beyond reasonable doubt

Deaths reported in 2020 were noted mostly relating to TACO (n=18) and delays (n=12). Pathological reactions, such as, febrile, allergic, hypotensive and haemolytic reactions did not feature as contributory to deaths. Details of reviews into the various reporting categories can be found in the relevant chapters in the report. Key factors identified in deaths relating to TACO and delays include lack of TACO risk assessments in vulnerable patients, delays in recognising major haemorrhage, communication errors and delays in reversal of anticoagulation when patients on anticoagulants present with major bleeding. Serial delays at different transfusion steps are cumulative and can result in harm or death. Transfusions with pulmonary complications contributed most to both deaths and major morbidity. Figure 3.4 shows the distribution of deaths related to transfusion reported in 2020.

Figure 3.4: Deaths related to transfusion (with imputability) reported in 2020 (n=39)



TRALI=transfusion-related acute lung injury; UCT=uncommon complications of transfusion; TAD=transfusion-associated dyspnoea; TACO=transfusion-associated circulatory overload

A detailed review of the transfusion-related deaths in the UK from 2020 can be found in the supplementary information on the SHOT website (https://www.shotuk.org/shot-reports/report-summary-and-supplement-2020/). Suboptimal investigation of these serious incidents is evident with RCA investigations performed and shared with SHOT for the single imputability 3 case and 4 of the 5 cases with imputability 2. RCA was performed for only 18 of the 33 imputability 1 cases, with 7 of these being shared with SHOT. A TACO checklist was stated to have been used pre transfusion in only 4/18 cases. There continues to be a lower threshold to blame individuals and missed opportunities to identify systemic factors that need to be improved when investigating incidents. A human factors driven incident investigation is key to driving sustained improvements in healthcare. Where intervention actions were identified they often referred to review of systems, review of education and/or process mapping with no tangible improvement actions. Reviews and process mapping should be part of the RCA, not cited as an improvement action and this is indicative of an incomplete RCA process. Action plans did not always include responsibilities for implementation, time frames or sustainability of actions, and very few included any review of the effectiveness of the actions.

COVID-19 appears to have contributed in some degree to the increase in transfusion-related deaths, being implicated as a co-morbidity in 5 TACO cases, but was not notable in cases of delayed transfusion, which are reviewed in detail in Chapter 12, Avoidable, Delayed or Under/Overtransfusion (ADU). Despite the pandemic causing a significant strain on health service resources, challenges with patient care were not cited in the investigation reports. Thorough investigation, including identification and implementation of improvement actions, is crucial in all potentially avoidable transfusion reactions and events and should be standard where there has been a death or major morbidity. All incidents should be considered in terms of future potential, it is impossible to know how many lives have been saved because RCA and intervention principles have been applied to near miss events and cases where there is no clinical harm, but it has surely been time well spent.

Trends in transfusion-related deaths

Figure 3.5 shows the distribution of causes of transfusion-related deaths reported between 2010-2020. These demonstrate that the risk of death from transfusions in UK remains very low. Changes in transfusion practices have resulted in a reduction in pathological transfusion reactions and deaths from infections. The main risks however are related to human factors. Pulmonary complications and delays in transfusions are now the main cases of transfusion-related deaths. Use of checklists, embedding the use of electronic identification systems, incorporation of human factors and ergonomics principles in transfusion practices will help in improving decision making in transfusion.

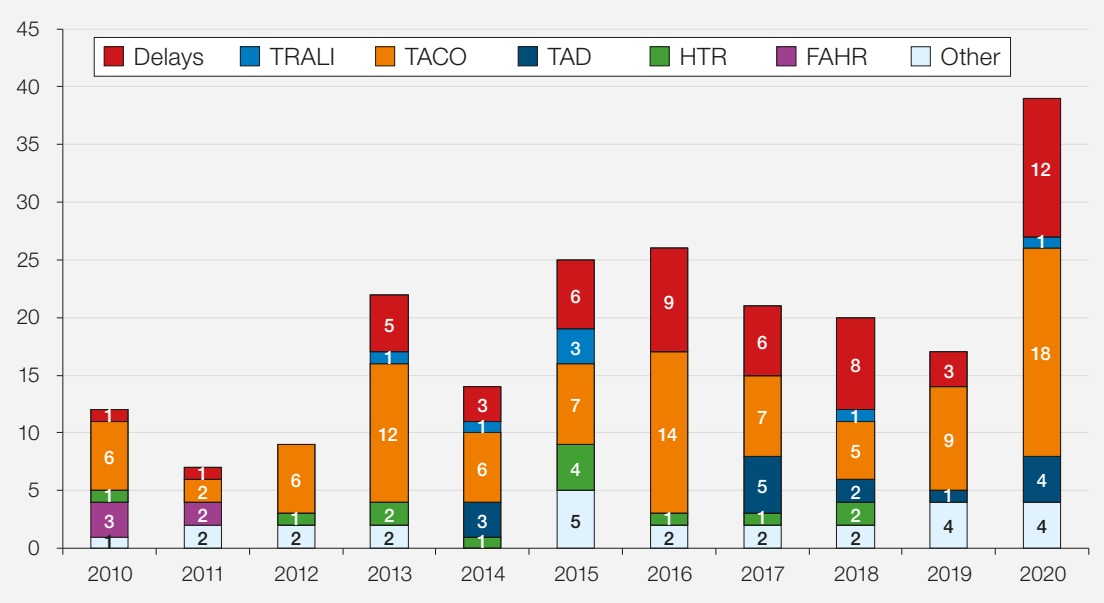


Figure 3.5: Transfusion-related deaths 2010 to 2020 (n=173)

TRALI=transfusion-related acute lung injury; TACO=transfusion-associated circulatory overload; TAD=transfusion-associated dyspnoea; HTR=haemolytic transfusion reaction; FAHR=febrile, allergic and hypotensive reactions

Please refer to the respective Annual SHOT Reports for further details regarding these deaths.

Improved decision making, patient monitoring and education, addressing factors contributing to errors, building safer systems and continued vigilance are vital in improving transfusion safety.

Major morbidity n=137

Febrile, allergic or hypotensive transfusion reactions and pulmonary complications continue to account for most of the cases with major morbidity. These are detailed further in the respective subject chapters in this Annual SHOT Report.

Major morbidity is defined in the SHOT definitions document as:

- Intensive care or high dependency admission and/or ventilation, renal dialysis and/or renal impairment
- Transfusion induced coagulopathy in association with treatment for major haemorrhage (due to the dilution of haemostatic factors following unbalanced resuscitation or overuse of crystalloid/colloid
- Evidence of acute intravascular haemolysis e.g. haemoglobinaemia, gross haemoglobinuria
- Life-threatening acute reaction requiring immediate medical intervention
- Persistent viral infection
- Acute symptomatic confirmed infection
- Sensitisation to D or K in an individual of childbearing potential
- Reaction resulting in a low or high Hb level of a degree sufficient to cause risk to life unless there is immediate medical intervention

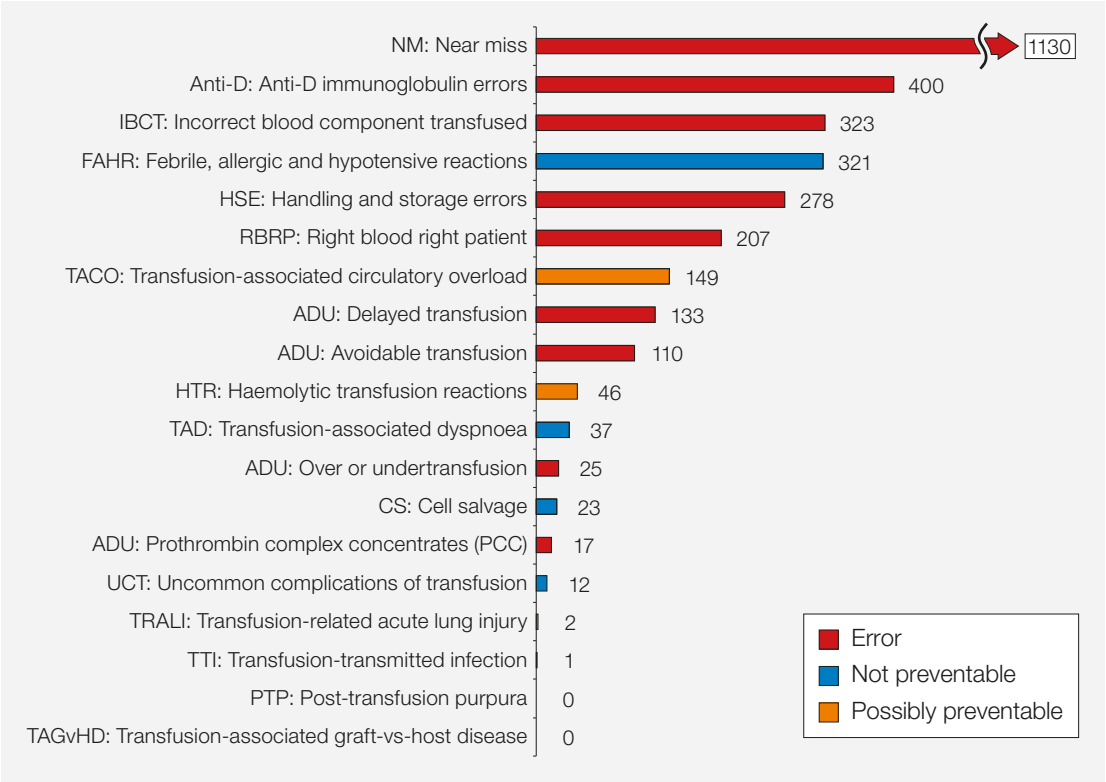
Potential for major morbidity is defined as:

- Potential risk of D or K sensitisation in an individual of childbearing potential

Summary data and risks associated with transfusion

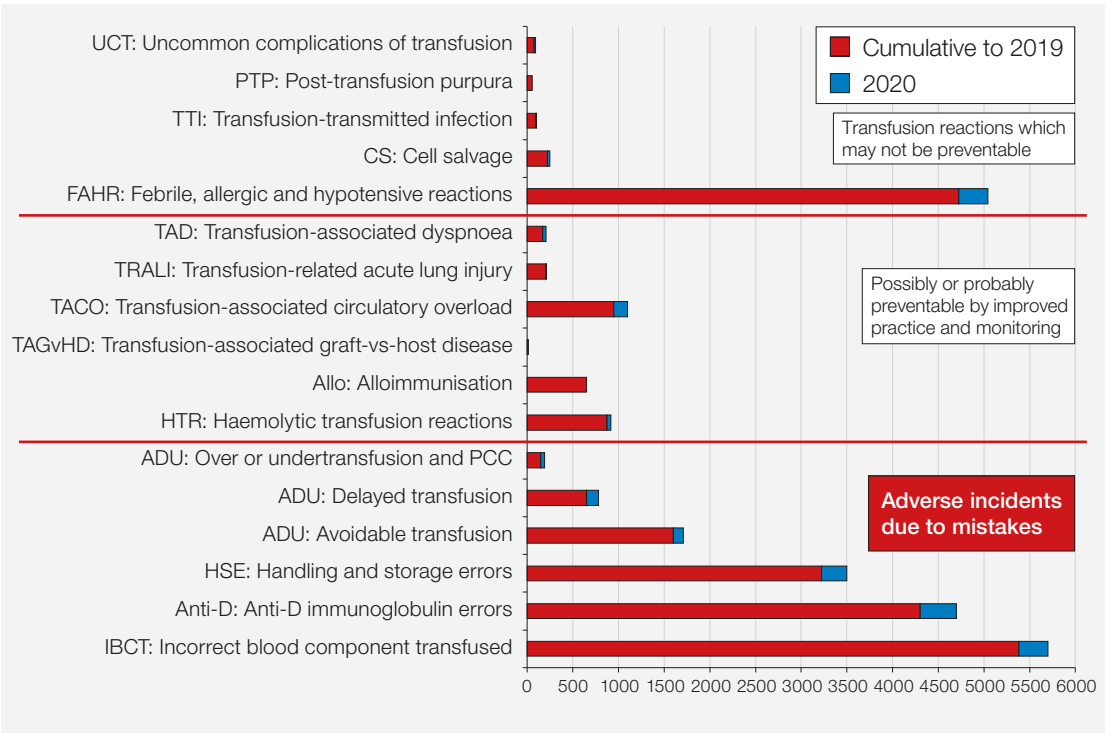
Data collected in 2020 are shown in Figure 3.6. Near miss continues be the category with the highest number of reports (1130/3214, 35.2%). Reporting and investigating near misses helps identify and control risks before actual harm results, providing valuable opportunities to improve transfusion safety.

Figure 3.6: Summary data for 2020, all categories (includes RBRP and NM) (n=3214)



There have been no cases of TA-GVHD or PTP reported in 2020. All transfusion staff need to be aware of these rare complications, prevention strategies and be able to recognise these promptly and manage appropriately. Cumulative data for 24 years are shown in Figure 3.7.

Figure 3.7: Cumulative data for SHOT categories 1996-2020 (n=25218)



**Data on alloimmunisation is no longer collected by SHOT since 2015*

The risk of death related to transfusions in the UK is 1 in 53,193 components and of serious harm 1 in 15,142 components issued in the UK. The risks of transfusion-transmitted infections are much lower than all other transfusion-related complications (see Chapter 21, Transfusion-Transmitted Infections (TTI)).

Cumulative risk data from SHOT

Figure 3.8 shows the number of reactions reported per 10,000 components issued in the UK between 2011-2020. Although red cells are the most common blood component transfused, platelets account for the highest number of reactions reported per 10,000 components. Platelet transfusions are associated with a high frequency of febrile and anaphylactoid reactions (Kiefel 2008). The same pattern is seen in the cases reported to SHOT and these are further elaborated in the FAHR chapter. The incidence of allergic reactions is lower with pooled platelets (suspended in PAS) than apheresis platelets and could most likely be associated with the reduction in plasma content. Reactions to platelets are at least in part caused by release of substances from the platelets themselves and therefore cannot be completely eliminated (Garraud et al. 2016, Maurer-Spurej et al. 2016).

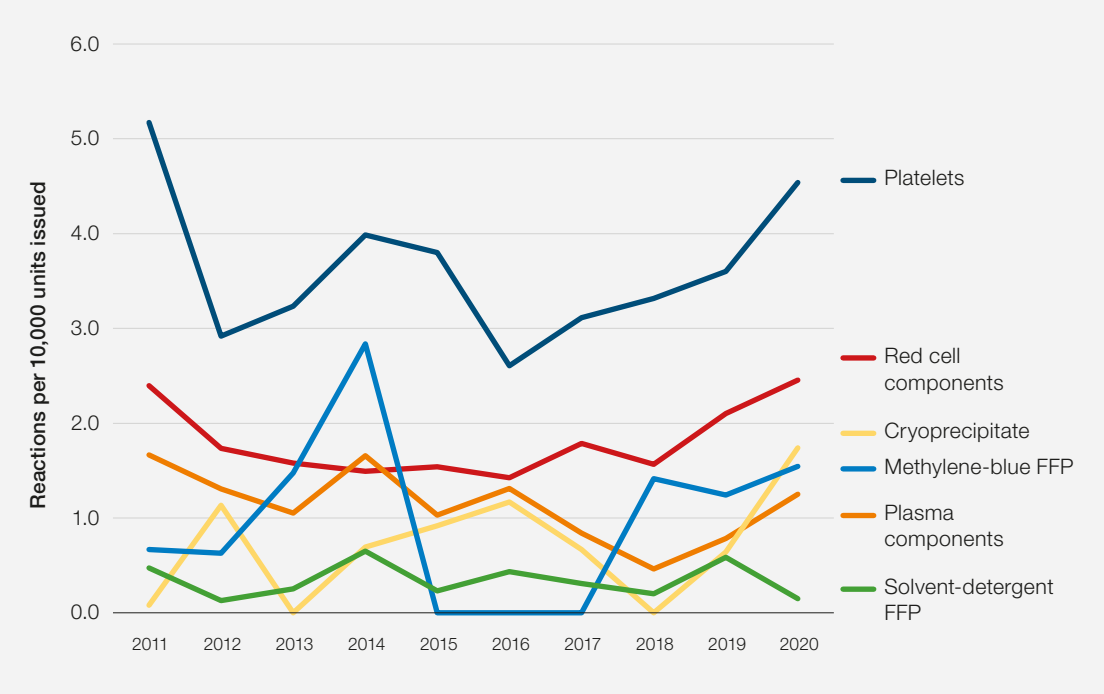


Figure 3.8: Reactions per 10,000 components, by component type 2011-2020

**Not including convalescent plasma*

The following table shows the risk of transfusion reactions based on SHOT data 2011-2020. It should be noted that these are based on the number of blood components issued as accurate data regarding actual number of transfusions is lacking. Notwithstanding a good reporting culture, variations in reporting over the years, changes in definitions, validation, and variation in practices should be considered when interpreting these data. Despite these limitations, the data are useful and provide valuable information about the risks for some of the common transfusion reactions reported to SHOT.

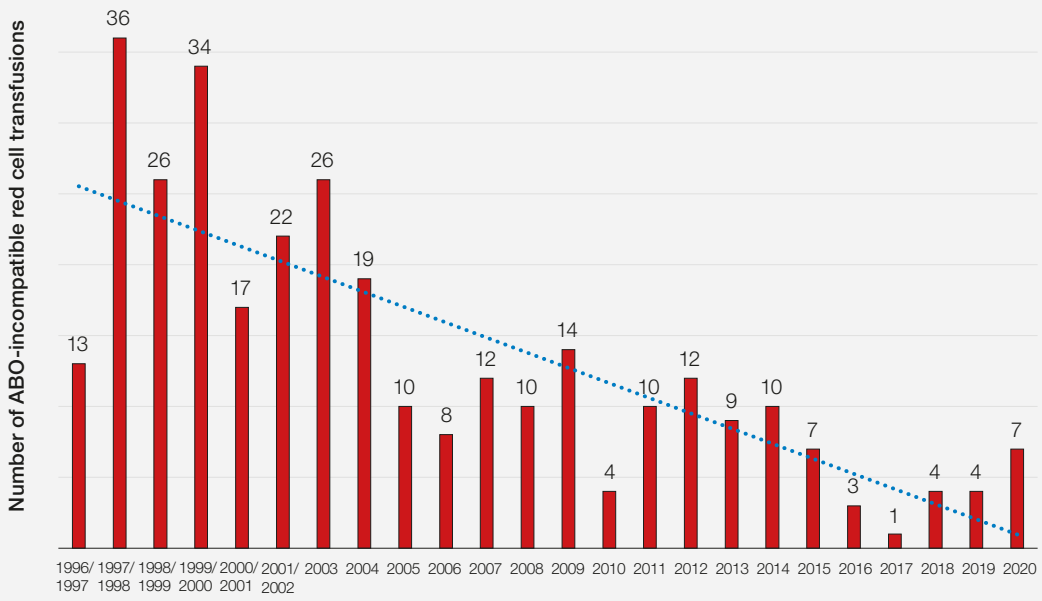
Table 3.2: Risk of transfusion reaction by reaction type 2011-2020

Transfusion reaction	Risk of transfusion reaction based on SHOT data 2011-2020
Febrile, allergic or hypotensive reactions	1 in 7,704
Transfusion-associated circulatory overload	1 in 25,313
Haemolytic transfusion reactions	1 in 57,425
Transfusion-associated dyspnoea	1 in 153,249
Transfusion-related acute lung injury	1 in 417,039
Post-transfusion purpura	1 in 2,543,940
Transfusion-associated graft vs host disease	1 in 25,439,401

ABO-incompatible (ABOi) transfusions n=9

In total, there were 7 ABOi red cell transfusions, 1 ABOi FFP transfusion and 1 related to COVID-19 convalescent plasma reported in 2020. There were no cases of ABOi reported in children. Transfusion took place out-of-hours (20:00-8:00) in 5 of these cases despite the transfusions being reported as elective in 3 of these 5 cases. It is important that unnecessary elective transfusions are avoided out-of-hours in stable patients when staffing levels and senior support available may be low. Staff need to be vigilant and patients need to be monitored closely irrespective of when they are transfused. Administration errors accounted for most of the ABOi transfusions (5/9, 55.6%). Errors at component selection (n=2) and collection (n=2) were seen in the other cases. These errors were not picked up despite staff using a pre-administration checklist in 8/9 (88.9%) cases and worryingly administration checks were not part of routine transfusion practice in one hospital. This is despite repeated SHOT recommendations and a recommendation from the Chief Medical Officer (Department of Health 2017). This safety check applied correctly could potentially have picked up these ABOi transfusions. Figure 3.10 shows the number of ABOi red cell transfusions between 2010 to 2020 that should have been identified at the pre-administration checks. Gaps in staff knowledge, lack of competency training, lone working, staff shortage, confusing SOP, dynamic situations, and high numbers of unqualified staff during the pandemic have been cited as causative and contributory factors. These are further described in Chapter 10, Incorrect Blood Component Transfused (IBCT). Figure 3.9 shows the number of ABOi transfusions reported to SHOT between 1996 and 2020.

Figure 3.9: Number of ABO-incompatible red cell transfusions 1996-2020



There is a slight increase in the number of ABOi reported in 2020 which could reflect the challenges faced in healthcare because of the pandemic. Nevertheless, every effort must be made to address these errors as these can potentially result in patient death and major morbidity.

Data from 2016-2020 show that although there were 19 ABOi red cell transfusions, there were 1495 near misses where an ABOi transfusion would have resulted, the majority of these are WBIT incidents. WBIT constitute the largest subset of near miss cases reported to SHOT in 2020, 673/1130 (59.6%) of all NM events, and these are discussed separately. These may not be detected routinely unless there is a historical record in the transfusion laboratory and demonstrate the importance of the group-check policy (BSH Milkins et al. 2013). These errors, which could have lethal outcomes, demonstrate the importance of positive patient identification at the time of collecting and labelling pre-transfusion samples. As with all NM, WBIT incidents provide valuable opportunities to learn and improve systems. As is evident from the iceberg representation below (Figure 3.11), these occur much more frequently and afford more opportunities to learn than the rarer serious adverse events. When they are not identified or investigated, they are missed opportunities that can contribute to future risks of potentially lethal ABOi.

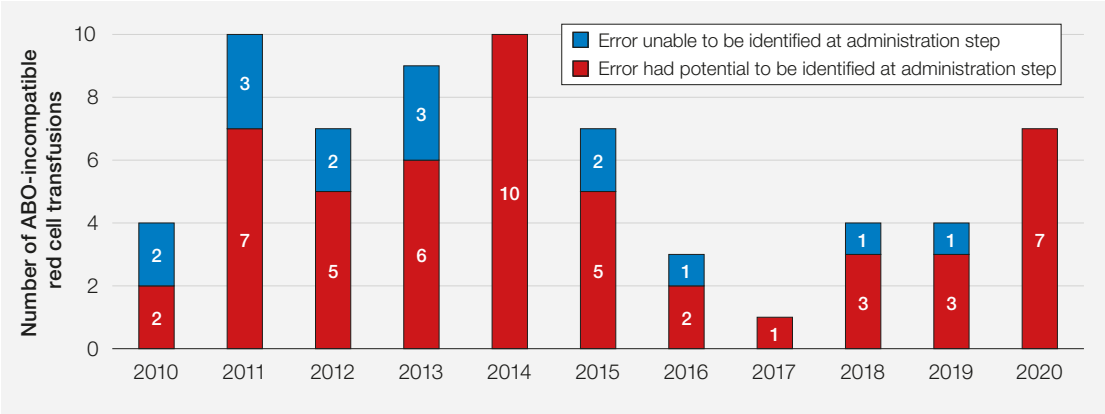


Figure 3.10: ABO incompatible red cell transfusions from 2010 to 2020 showing the importance of the pre-administration checks

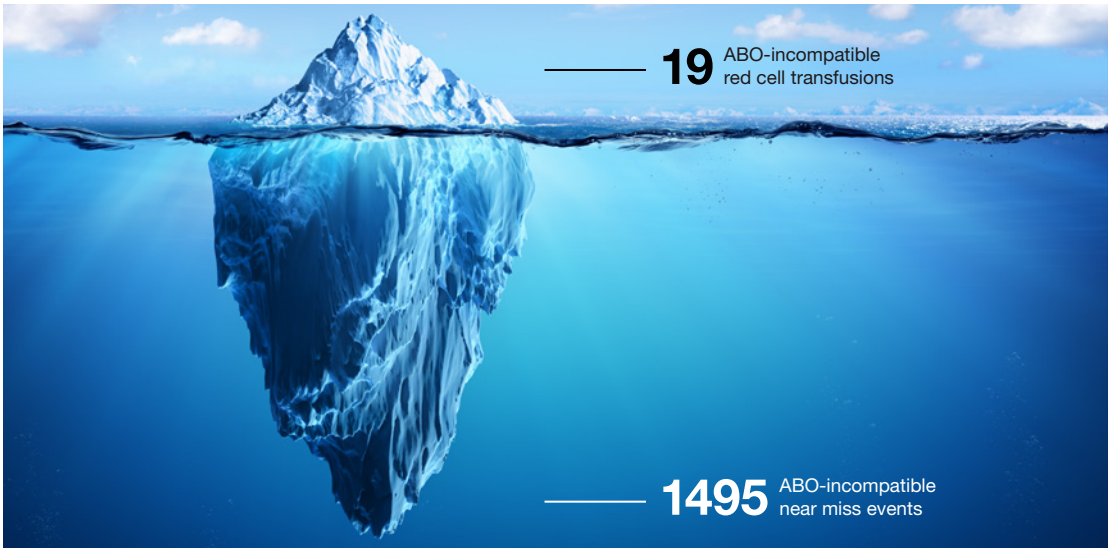


Figure 3.11: ABO-incompatible transfusions 2016-2020: few events (n=19) but many near misses (n=1495)

Investigating these incidents, including WBIT, using human factors principles will help identify the causal and contributory factors; and will inform the corrective and preventive actions to improve patient safety. This year one of the ABOi cases has been worked through using the new SHOT human factors investigation tool (HFIT) (incorporating the Yorkshire Contributory Factors Framework) and the Systems Engineering Initiative for Patient Safety (SEIPS) model to illustrate the benefits of applying human factors principles and systems thinking to incident investigations- both these re-worked investigation reports can be accessed online (https://www.shotuk.org/shot-reports/report-summary-and-supplement-2020/).

Transfusion errors reported in HSCT patients n=44

Transfusion errors continue to be reported in HSCT recipients. Most errors in this group of patients reported in 2020 involved IBCT-WCT (n=17) and IBCT-SRNM (n=15), a similar theme to that reported in the 2019 Annual SHOT Report which included an 8-year review. NM errors (n=12) were those detected prior to the transfusion and included 2 WBIT events. A detailed analysis of these errors can be found in the supplementary information on the SHOT website (https://www.shotuk.org/shot-reports/report-summary-and-supplement-2020/).

Robust communication processes must be in place between the transplant centre, all laboratories providing transfusion support, the referring centre, and any other shared care organisations. Communication must include specific requirements and recommendations for safe ABO/D component support along with the date of the transplant. Laboratories must have reliable processes for adding the specific requirement information to the patient record in the LIMS in a timely manner. Information relating to specific requirements must be easily accessible in the LIMS, flag and alert functionality must be used to its full potential to support safe provision of components. Laboratories must ensure that patients who have received an ABOi HSCT are excluded from electronic issue. These measures will help ensure safer transfusions in these patients.

Conclusion

Incident reporting is vital for improving safety in healthcare. The actual value from local and national reporting lies in learning from the various incidents, recognising gaps in practices, identifying areas for improvement, and carrying out appropriate actions. Recommendations from SHOT following analysis of the transfusion incidents must be used to identify what can be done locally in each Trust or Health Board to improve patient safety. Otherwise we risk collecting reports without positively impacting transfusion safety. Leaders and managers need to be aware of the people-related, cultural, and organisational issues that may prevent lessons from being learned effectively in their organisations. Organisational learning is a key aspect of health and safety management. If reporting and follow-up systems are not fit for purpose, for example if a blame culture acts as a disincentive to reporting near misses, then valuable knowledge will be lost. If the root causes of precursor events are not identified and communicated throughout the organisation, this makes a recurrence more likely. Siloed working in healthcare inhibits organisational learning. All these factors must be addressed to optimise learning and improve systems.

Ensuring transfusion process safety is as important as blood component safety and quality. Potential for serious problems exists at each step in the process of transfusion and learning from incidents reported should drive improvements in healthcare.

Recommended resources

SHOT Bite No. 1a and 1b: Incident Investigation
SHOT Bite No. 17: Near Miss
https://www.shotuk.org/resources/current-resources/shot-bites/

Safe transfusions in transplants document
https://www.shotuk.org/resources/current-resources/

A guidance tool for TACO investigation is available
https://www.shotuk.org/resources/current-resources/

SHOT
Serious Hazards of Transfusion

References

BSH Milkins C, Berryman J, Cantwell C, et al. Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories. *Transfus Med* 2013;**23(1)**:3-35. http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3148.2012.01199.x/full [accessed 25 March 2021].

BSH Robinson S, Harris A, Atkinson S, et al. The administration of blood components: a British Society for Haematology Guideline. *Transfus Med* 2018;**28(1)**:3-21. http://onlinelibrary.wiley.com/doi/10.1111/tme.12481/full [accessed 25 March 2021].

Department of Health. Safe transfusion practice: use a bedside checklist (CAS) CEM/CMO/2017/005 (2017). https://www.cas.mhra.gov.uk/ViewandAcknowledgment/ViewAlert.aspx?AlertID=102663 [accessed 25 March 2021].

Garraud O, Tariket S, Sut C, et al. Transfusion as an Inflammation Hit: Knowns and Unknowns. *Front Immunol* 2016;**7**:534.

Kiefel V. Reactions Induced by Platelet Transfusions. *Transfus Med Hemother*. 2008;**35(5)**:354-358. doi:10.1159/000151350

Maurer-Spurej E, Larsen R, Labrie A, et al. Microparticle content of platelet concentrates is predicted by donor microparticles and is altered by production methods and stress. *Transfus Apher Sci*. 2016;**55(1)**:35-43.