6 Human Factors in SHOT Error Incidents n=2905

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Key SHOT messages

- Incident investigators should analyse events fully to uncover all system failures, because research has shown it is uncommon for an individual staff member to be solely responsible for an incident. If the investigation places too much emphasis on human error, the opportunity may be lost to prevent further incidents by amending underlying system issues
- Knowledge and understanding of human factors and ergonomics principles will help reporters to assess all aspects of incidents to promote further learning
- Analysis of error cases reported to SHOT continues to show that previous SHOT recommendations, learning points and key messages have not always been fully implemented. SHOT suggest a periodic review of these using the relevant Annual SHOT Report tools that are available in the resources section of the SHOT website, including both current and archived resources https://www.shotuk.org/resources/
- SHOT strongly encourage hospital staff to participate fully in the National Comparative Audit of Blood Transfusion (NCA) vein to vein continuous voluntary audit

For the last few years SHOT has highlighted the importance of human factors and ergonomics (HFE) when reporting transfusion incidents. Since 2016 a human factors investigation tool (HFIT) has been linked to the SHOT on-line reporting database (Dendrite™), which asks reporters to score four factors out of 10: Staff, environment (e.g. local workspace), organisation (e.g. Trust/Health Board issues) and government/regulatory factors. Lessons learned from those questions have been published in the last two Annual SHOT Reports (Bolton-Maggs et al. 2017 and 2018). The major conclusions in both years were that scores attributed to staff members as a cause of error were higher than scores given to other potential human factors. From January 2017 a self-learning package was made available to help reporters consider all the human factors aspects of adverse incidents https://www.shotuk.org/reporting/human-factors-tuition-package/ and in January 2018 a link to a simple animated video demonstrating healthcare human factors was also added https://t.co/qTeUoPiUlq. It is disappointing that in 102/2905 (3.5%) cases the reporter identified that they could not access a video from their organisation's information technology (IT) system, hence could not view the human factors presentation. This comment related to 36/191 (18.8%) of the different reporting organisations that submitted reports to SHOT in 2018.These were mainly National Health Service (NHS) Trusts/Health Boards, but also included some independent healthcare providers. In an era when many individuals can access media such as videos from their mobile phone, outdated or restricted institutional IT in nearly 1 in 5 healthcare organisations may be reducing opportunities to enhance learning, not only of HFE principles, but also any other video-based education and continuing professional development.

Figure 6.1 shows the comparison of percentage scores given for the four human factors categorised by the uptake of self-learning opportunities by reporters. The percentages in the labels of each column for 2017 and 2018 represent the cases pertaining to that category, i.e. approximately three-quarters of cases were reported by individuals who had availed themselves of that learning opportunity, while in about a quarter of cases the reporter had not stated they used the self-learning material. These data show that over the last three years, there has been very little change in the distribution of scores given to

the four human factors, although the trend across the three years is to assign slightly less responsibility to the staff members, especially if the self-learning package has been read.

A statistical analysis of the data from all three years since the HFIT was introduced has shown there is some limited evidence that the use of self-learning led to a reduction in the extent to which reporters attributed staff as a cause of the incident, p=0.10. There is strong evidence that the use of self-learning increased the extent to which reporters attributed environment, organisation, and regulation as contributing to the incident, p<0.0001 for all three human factors. Therefore, when the incident reporter has used some form of self-learning, the attribution of culpability to staff is reduced and for each of environment, organisation, and government/regulatory is increased. SHOT strongly encourages reporters to use human factors and ergonomics principles to help assess all causes of an incident.

It is uncommon for an individual staff member to be solely responsible for an incident and research has shown that 90% of quality lapses are defined as blameless for the individual (Karl and Karl 2012 and Reason 1997). If the investigation of incidents places too much emphasis on human error, the opportunity to resolve underlying system problems may be lost. As an illustration 427/2905 (14.7%) cases were scored as 10/10 for 'attributable to unsafe practice by individual staff member(s)', with no scores given for any other system problem. Of these cases, 83/427 (19.4%) gave an answer to a new question asked for the first time in 2018 'If you could change one thing to make this incident less likely to happen again, what would it be?'. Many of these replies indicated a change in the system, which suggests the cause of incident is unlikely to have been solely attributable to a staff member. A few examples of system changes listed are:

- Vein to vein blood sampling and labelling (similar comments were made several times)
- A biomedical scientist (BMS) should issue all components day and night
- The clinic sheet did not contain the patient's D group; column now added to the document
- Implementation of the bedside checklist, which is currently in progress
- A range should be developed to reduce calculation errors for neonates and children
- Use electronic communication, not an old fashioned written book
- The correct patient's notes must be on the correct patient's bedside
- Better understanding of iron deficiency anaemia and the risks of transfusion-associated circulatory overload (TACO)

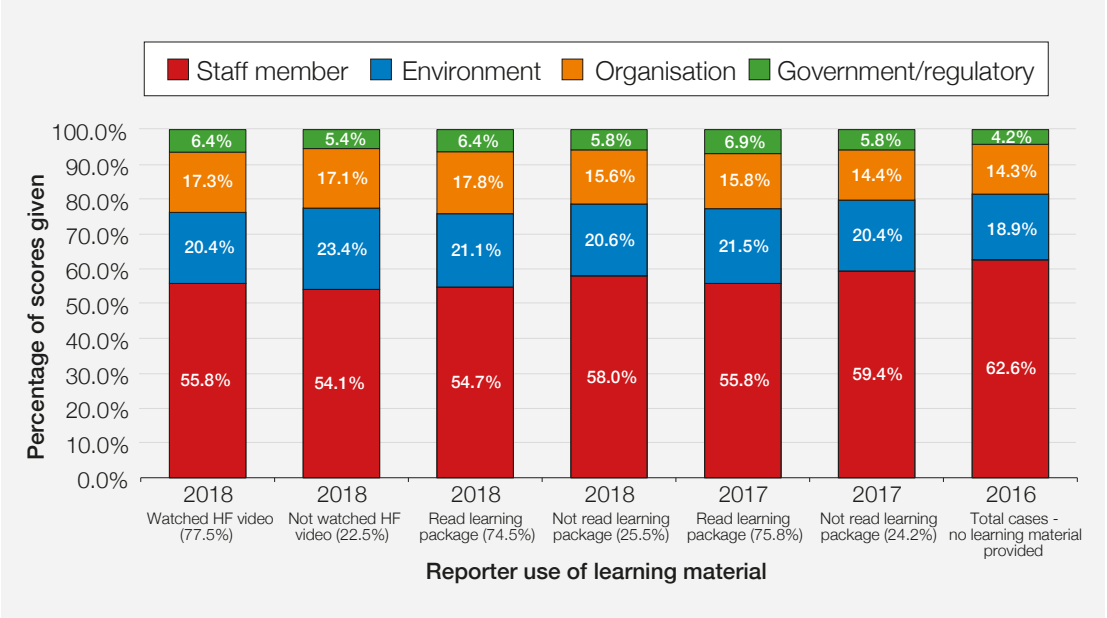

Figure 6.1: Evaluation of uptake of self-learning opportunity and comparative percentages of scores for human and organisational factors

Percentages in column labels=proportion of cases where the reporters used/did not use learning material

HF=human factors

Case 6.1: Culpability attributed solely to staff member(s), but system problems also identified

The clinical picture and observations supported acute blood loss, so fluids were started in recovery and a venous blood gas was taken (now thought to be from the drip arm). The haemoglobin (Hb) result was 50g/L compared to a preoperative Hb of 145g/L. A venous blood sample sent to the laboratory gave a Hb result of 19g/L, with abnormal clotting, and again this is thought to have been from the drip arm. Laboratory staff deleted all results except the Hb and clotting screen and added a comment to repeat these tests as they were spurious results. There was clear indication that the Hb result of 19g/L was incorrect as comments were added. It is unusual that a result of 19g/L would be reported and the laboratory manager has concluded all the results should have been removed and not validated. Two units of red cells were crossmatched for transfusion within 15 minutes of these erroneous results being received. A repeat full blood count (FBC) was not taken until after the two units had been transfused (post-transfusion Hb 105g/L). It is difficult to know if the blood gas Hb of 50g/L was correct, but the post-transfusion Hb results suggests it was from a drip arm. A review of observations, including a drop in blood pressure, shows they were consistent with acute blood loss and with a post-transfusion Hb of 105g/L it is likely that this patient would have needed transfusion regardless of the erroneous results. However, one unit may have been sufficient.

Lessons learnt: samples should not be taken from a drip arm; spurious results should be deleted, with new samples requested and, if clinically indicated, a single unit should have been transfused.

Case 6.1 was scored as 10/10 for individual culpability with no scores for other human factors. However, the incident report shows several learning points related to clinical procedures and laboratory systems. As no scores were assigned to system and organisational problems, it is possible that opportunities to improve the processes might have been missed, such as introducing electronic barriers to prevent transmission of grossly abnormal results. A recommendation and a learning point from the 2013 Annual SHOT Report (Bolton-Maggs et al. 2014) are alluded to in this case, but may not have been fully implemented yet: (1) Don't give two without review, which was inspired by a campaign devised by NHS Blood and Transplant (NHSBT)'s Patient Blood Management team advising to give only one unit of red cells, then check the results before further transfusion, (2) Inappropriate transfusions could be avoided if laboratories did not transmit results they know or suspect to be inaccurate, but instead requested a second sample.

In 309/2905 (10.6%) cases, no score was given for any of the four factors, which may reduce the chances of the incident investigators making recommendations for system-related actions. Case 6.2 is a good example of an incident investigation that has identified many system issues, but no scores were entered into the SHOT questionnaire to identify the contribution of these factors to the incident.

Case 6.2: No scores given for human factors, but many system issues were identified

A patient was prescribed fresh frozen plasma (FFP) but cryoprecipitate was issued from the transfusion laboratory. The error was not detected at collection or at the final bedside administration, so an incorrect component was transfused. The following organisational and system problems were identified in the incident investigation:

- *Busy night shift and lone working, so laboratory worker was tired*
- *There was no second check in the laboratory due to lone working*
- *The cryoprecipitate had been put in the wrong section of the freezer*
- *Due to staffing levels a routine stock check had not taken place when scheduled*
- *The laboratory information management system (LIMS) did not state the component being issued (LIMS now changed to do this and a new electronic blood-tracking system is planned)*
- *Two units were brought to the ward, but only one had been requested*
- *The ward was very busy*
- *The blood component label has small print which was being read in poor lighting*
- *Second check on the ward was done by a nurse who had just returned from a break*

- *Nursing knowledge and understanding of the different components may be an issue*
- *A safety critical checklist resource for staff to carry and access at the bedside is to be developed*
- *The transfusion record is to be updated to include a components section as part of the pre-transfusion checklist*

Themes emerging from this case show problems with technology (LIMS issues and no blood-tracking), staffing levels (lone working and workload); procedures (second checks and checklists), education (staff knowledge) equipment design (label print, lighting). These are all work environment, organisational or government level issues, i.e. not directly staff-related. Revealing these system-related issues in an incident investigation and scoring them appropriately in the SHOT questionnaire may encourage greater learning about the underlying factors that can lead to adverse events.

Vein to vein audit

SHOT has been working with the NCA of blood transfusion on a suite of audit tools to cover all the nine steps of the transfusion process, which SHOT has defined and used for analysis since 2013 (Bolton-Maggs et al. 2014). This is known as the vein to vein audit and the audit tools are currently being trialled before a launch for use by all hospitals later in 2019 (NCA 2018). This audit will be continuous voluntary audit, but SHOT strongly supports this audit and encourages hospital staff to participate as fully as possible.

Within the tools there will be two human factors questions, to be asked at each step, from which we can assess resilience in the transfusion process. These consist of an open narrative question to encourage staff to describe adaptations voluntarily and a follow up question to score the level of support received from management. These questions have already been tried throughout the complete transfusion process in a few hospitals and SHOT would like to thank the anonymous volunteers who facilitated those pilot sessions. Early data from the trials showed that staff make many adaptations to standard procedures in transfusion and these have been categorised into: 1) preferred adaptations, which are developments expected to improve the process and 2) forced adaptations, which are workarounds and coping strategies when ideal solutions are outside of their control. Adaptations are made within staff members' sphere of influence and largely without the knowledge of management (Watt et al. 2019a). Further analysis has been done of the pilot data in collaboration with the Human Factors in Complex Systems group at Loughborough University Design School. The analysis shows some interesting insights into the limitations of adaptations and how this affects resilience in the transfusion process. This work is awaiting publication (Watt et al. 2019b).

Commentary

The importance of HFE continues to be recognised by major healthcare organisations as demonstrated by several publications in 2018. The Healthcare Safety Investigation Branch (HSIB) Annual Review 2017/18 defines that their investigation model is based on a deep knowledge of human factors (HSIB 2018, p.2). The Care Quality Commission (CQC) document Quality Improvement in Hospital Trusts encourages a systems approach to quality improvement in hospitals (CQC 2018a, p34) and their analysis of Never Events in 2017-18 highlights that the overwhelming majority require human factors based solutions (CQC 2018b, p4). Also, the General Medical Council (GMC) has published plans to embed human factors into the investigations of adverse events by rolling out human factors training to all their fitness to practise decision makers, case examiners and clinical experts (GMC 2018). The Nursing and Midwifery Council (NMC) first included reference to human factors in their code of conduct published in 2015 and this was recently updated in October 2018 (NMC 2018, p17).

SHOT strongly encourages transfusion professionals to attain as much knowledge as possible about HFE principles that can be incorporated into their day-to-day work. Understanding HFE would be particularly useful when investigating serious incidents in order to identify system and organisational problems, which could lead to more effective corrective and preventative actions.

Acknowledgement

SHOT would like to thank Frances Seeney and Mark Jones from NHSBT's Statistics and Clinical Studies department for providing a statistical analysis of three years' data from the Human Factors Investigation Tool.

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