2020 Annual SHOT Report – Supplementary information

Chapter 8: Human Factors

Case Study reworked using updated HFIT and SEIPS framework

Introduction:

Reporting incidents helps provide a greater understanding of safety risks, identify mitigating measures, and prevent reoccurrences. This builds a safety-minded culture and learning from lessons within the organisation.

Adverse events are rooted in system failures. Applying human factors principles to all patient safety and quality improvement practices helps promote an integrated, evidence-based and coherent approach to safety, quality and excellence of care provided. One of the main SHOT recommendations from the 2018 Annual SHOT Report was to ensure all clinical and laboratory staff are familiar with human factors and ergonomics (HFE) concepts and it was proposed that organisations have access to HFE experts. HFE expert facilitated systemic incidents analysis with healthcare stakeholders can enable effective and efficient patient safety incident investigation identifying improvement actions for underlying system issues beyond individual issues.

It is also widely recognised that with healthcare systems being complex, a 'systems thinking' approach to improvement must be adopted as it may improve the ability to understand current work processes, predict system behaviour and design modifications to improve related functioning. 'Systems thinking' involves exploring the characteristics of components within a system (e.g. work tasks and technology) and how they interconnect to improve understanding of how outcomes emerge from these interactions. It has been proposed that this approach is necessary when investigating incidents where harm has, or could have, occurred and when designing improvement interventions.

This year, one of the ABO incompatible red cell transfusion cases reported to SHOT has been worked through using the updated SHOT Human Factors Investigation Tool and SEIPS (Systems Engineering Initiative for Patient Safety) framework using the investigation report supplied by the reporting organisation. Please note that this case was selected randomly and has been used only to illustrate the importance of applying human factors principles and systems thinking to incident investigations and is by no means a criticism of the submitted report. Confidentiality, with respect to patient, staff and organisational details was maintained throughout this exercise.

Dr Alison Watt, the SHOT HF expert and Mrs Emma Milser, SHOT Haemovigilance/Patient Blood Management Specialist have illustrated the case using the SHOT HFIT model and this is covered in pages 2-7 of this document with input from the SHOT team. Application of the SEIPS framework has been shown from page 8-15. This has been a collaborative exercise between SHOT and colleagues from NHS England

and NHS Improvement. The following are the key individuals from the NHSEI team who were involved in this exercise:

- Tracey Herlihey, Head of Patient Safety Incident Response Policy
- Jayne Wheway, Patient Safety Clinical Lead for Children & Young People and Human Factors,
- Ethel Oldfield, Head of Patient Safety Oversight & Alerts
- Matt Fogarty, Deputy Director of Patient Safety (Policy and Strategy)
- Lauren Mosley, Head of Patient Safety Implementation

Applying human factors principles: SHOT HFIT

Background and commentary

SHOT has introduced a new Human Factors Investigation Tool (HFIT) in 2021 which incorporates the Yorkshire Contributory Factors Framework (YCFF) to evolve and drive their Human Factors strategy. The framework is a tool used for investigating and capturing systemic factors as well as individual factors where errors and events have occurred. This Framework has an evidence base for optimising learning and addressing causes of patient safety incidents by helping SHOT, clinicians, risk managers and patient safety officers identify contributory factors incidents.

As three quarters of all incidents reported to SHOT are related to errors, we would like to understand more about why these occur. Errors in transfusion practice may be related to workplace features, and we need to have an enquiring nature in our practice, asking questions such as: *"What are the Human Factors that contribute to errors in transfusion practice?"*

The aim of human factors analysis is not to ignore individual accountability for unsafe practice, but to develop a more sophisticated understanding of the factors that cause incidents. These factors can then be addressed through changes and recommendations in systems, structures, and local working conditions. Finding the true causes of patient safety incidents offers an opportunity to address systemic flaws effectively, for the benefit of transfusion patient safety.

The index case used in this exercise was originally scored 10/10 for the contribution of the individual staff member(s), and there were no other scores allocated for the other categories of the HFIT (2016-2020), these were Environment, Organisation and Government/Regulatory. However, the comprehensive investigation undertaken for this case identified several contributory factors. The SHOT Human Factors experts have reviewed the case and re-scored it against the factors identified in the investigation report using the updated HFIT for 2021 to demonstrate its application. It was recognised that the previous HFIT had limitations in the depth of information gathering for contributory factors. It is hoped that by illustrating the comparisons between the two tools, reporters can gain understanding of the rationale for updating them.

The HFIT sections for the case have been completed in depth by SHOT experts as a demonstration only. It is acknowledged that reporters may not add as much information, especially if full investigation documents have already been uploaded to the report.

Case 8.3 - Confusion over documentation leads to incorrect transfusion

A patient (patient 1) was being treated with chemotherapy. During an outpatient consultation it was noted that the patient's Hb had dropped to 44g/L and they were admitted to hospital for an urgent blood transfusion of 3 units of red blood cells. The first 2 units were transfused without any issues. A few minutes after the 3rd unit was commenced the patient complained of an impending sense of doom. The medics were dealing with an emergency elsewhere and advised giving hydrocortisone and chlorphenamine and to restart the blood if the patient settled. The medication was given as advised and the patient initially responded to the treatment and became settled but subsequently developed rigors. It was then noted that the unit of blood connected to the patient was intended for another patient with the same surname.

Staff from the security team are allocated to collect blood components overnight. A member of security staff went to the ward to obtain the paper collection card and then went to the blood collection room. This collection card contained the details of patient 1.

The staff member selected the correct compatibility slip in the blood collection room folder, placed the ward collection card in the appropriate box and went to the fridge to collect the unit of blood. They recalled that the blood was not in the allocated shelf as indicated on the compatibility slip and lost the correct place in the compatibility folder but could recall the patient's surname. Patient 2's compatibility slip was selected, and the unit of blood intended for patient 2 was collected using the slip.

The blood component should be tracked and signed out on Clinical Web Portal (CWP) using the computer in the blood room but the member of staff was unable to log on that evening and had experienced issues previously with the PC in this respect.

The blood was taken to patient 1's bedside and verbal checks were attempted but the patient complained about being woken up. The nurse recalls checking the surname (same surname as patient 2) on the patient's wrist band and commencing the transfusion.

Case 8.3

Original Human Factors scores given using HFIT (2016-2020)

Cause attributable to unsafe practice/conditions associated with:	Score out of 10
Individual staff member(s)	10
The local environment or workspace	0
Organisational or management issues in the Trust/Health Board	0
Government, Department of Health or high-level regulatory issues	0

Case 8.3

Human factors scores using updated HFIT and reworked using contributory factors identified in the RCA. For the questions below the scale has been applied:

0 None, 1 Barely, 2 A little, 3 Some, 4 A lot, 5 Fully

Section 1 – Situational Factors	
To what extent is the cause of this incident due to any failures in team function?	**3**
To what extent did individual staff factors make this incident more likely?	**4**
To what extent did task features make the incident more likely?	**3**
To what extent were there reasons that this incident was more likely to occur to this particular patient	**4**
Please give any additional relevant information for situational factors The incident took place overnight, so there were several situational factors. The ward was extremely busy, and staff were still catching up on work that had fallen behind due to late admissions. The qualified nurse was on duty with a Band 4 who was moved elsewhere and replaced with a band 2 “bank” member of staff. The staff member that was moved was familiar with the ward environment whereas the replacement member of staff was not. In addition, the band 4 may have been able	

to carry out a wider range of supportive tasks to support the qualified nurse, e.g. patient observations. There was distraction from other distressed patients. The transfusion recipient complained about being woken up for PID checks. Other patients complained about noise and light. Two patients were on the ward with the same surname and both had blood issued. The staff group collecting blood only performed this task out of hours. Correct bedside administration policy was not followed.	
Section 2 – Local Working conditions	
To what extent was there a mismatch between workload and staff provision around the time of the incident?	**4**
To what extent was there any failure of team function in relation to leadership, supervision, and roles?	**3**
To what extent were there any difficulties obtaining the correct equipment and/or supplies?	**4**
Please give any additional relevant information for local working conditions As above, the replacement of an experienced Band 4 with a band 2 “bank” member of staff would have an adverse effect on local working conditions. Problems were also exacerbated by patient-related issues, such as the recipient not complying with PID checks and complaints from other patients. Working conditions were impacted by having two patients on the ward with the same surname and the probable inexperience of security staff, who only collect blood out of hours. In addition, there was an IT issue during the collection process that prevented the staff member from logging into the correct system, manual checks were missed at this point.	
Section 3- Organisational Factors	
To what extent did the environment hinder work in any way?	**4**
To what extent were there problems in other departments that contributed?	**4**
To what extent did organisational pressures play a role in the incident?	**5**
To what extent were there issues or gaps with staff skill or knowledge?	**3**
Please give any additional relevant information for organisational factors	

There were unprecedented bed capacity issues and pressure on patient flow resulting in admissions of patients into the night. Patient 1 was moved from one ward to another while the transfusion was underway. A further organisational factor was that some training resources were identified to have gaps and were in the process of being updated.	
Section 4- External Factors	
To what extent were there any characteristics about the equipment that were unhelpful?	**5**
To what extent have any national policies or high-level regulatory issues influenced this incident?	**1**
Please give any additional relevant information for external factors External factors included an IT issue during the collection process that prevented the staff member from logging into the correct system. Electronic tracking was not in place at the organisation and this was identified as a gap and an action within the investigation. This is a NICE transfusion recommendation for organisations, therefore high-level regulatory issues could have been given more weight. Electronic tracking was also cited by the SHOT reporter as the key factor that could prevent a similar incident recurring.	
Section 5- Communication and Culture	
To what extent did a lack of safety culture in your clinical area contribute to this incident?	**2**
To what extent did poor written, or verbal communication worsen the situation?	**2**
Please give any additional relevant information for communication and culture Poor communication meant there was a missed opportunity, as per local policy/indication, for the patient to have been transfused at an earlier appointment date, before the Hb dropped even lower from 80g/L to 44g/L.	

Section 6- Summary	
Which are the most important contributory factors for this incident? There were multiple contributing factors in this case other than the individual staff member. Organisational and Situational factors, and Local Working conditions scored highly in particular.	
If you could change one thing to make this incident less likely to happen again, what would it be? Electronic tracking was the response provided within the SHOT report. Such system changes are imperative if errors are to be reduced and recurrence prevented. IT systems when used effectively can make it easier for staff to follow the correct procedure and harder to make errors by detecting deviations in the process. It is recognised by SHOT experts that identifying one factor only can be difficult in a complex case with multiple steps and factors identified, and this question will be reviewed in the future.	

Healthcare is a complex socio-technical system, but what does this mean?

A system can be defined as *"a set of elements of parts that is coherently organised and interconnected in a pattern or structure that produces a characteristic set of behaviours, often classified as its 'function' or 'purpose'"* (Meadows, 2009, p188) and can be described across several dimensions including from simple to complex.

A simple system is akin to a recipe – it is linear with predictable outcomes. Complicated systems (e.g., a car or construction) may be intricate and consist of many parts but can be taken apart and put together again. Complex systems are highly variable, uncertain, and dynamic. They emerge from interactions between system components and can never be completely specified. Cars become part of a complex system when they are deployed on a road with weather and varied lighting conditions and many other vehicles and drivers with diverse training and experience and differences in risk perception.

A sociotechnical system is a system characterised by multiple interactions between various components, both human and technological.

What is SEIPS?

The Systems Engineering Initiative for Patient Safety (SEIPS) is a framework for understanding outcomes within complex sociotechnical systems. The framework was first introduced in 2006 (Carayon et al. 2006) and refined in 2013 to SEIPS 2.0 (Holden et al., 2013). In 2020 SEIPS was extended to include multiple interactions with the healthcare system over time (SEIPS 3.0, Carayon et al., 2020) and very recently a more simplified version of the model was published along with tools for direct use in practice (SEIPS 101, Holden and Carayon, 2021).

SEIPS describes how a sociotechnical system (or 'work system', left) can influence work done (processes, middle) by professionals and non-professionals, which in turn shapes outcomes for patients, professionals and organisations (right) – see Figure 1. It acknowledges that complex sociotechnical systems constantly adapt.

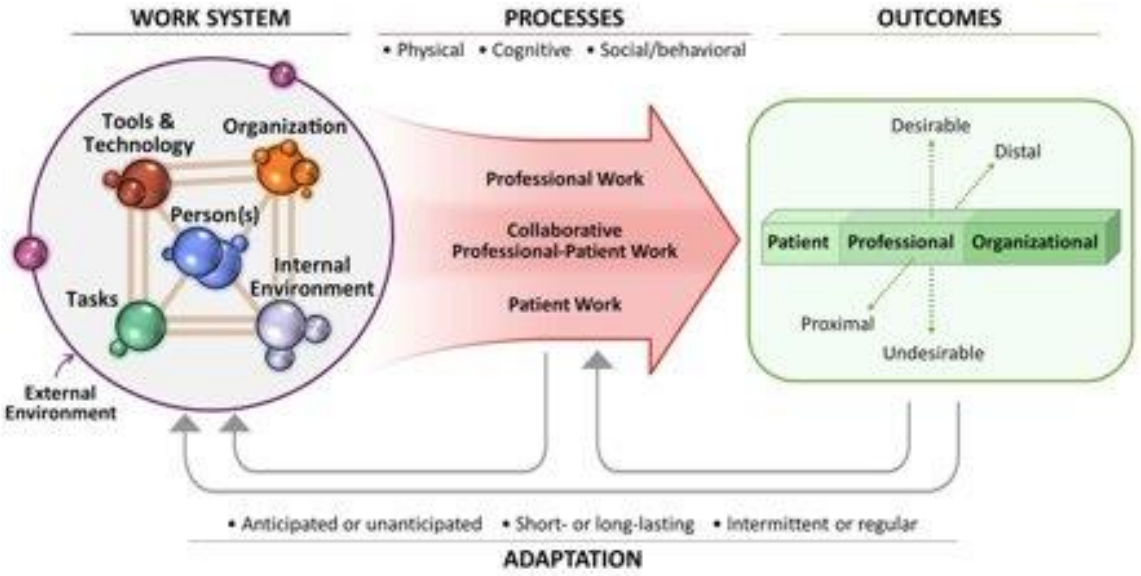

Figure 1. Overview of the SEIPS 2.0 model (Holden et al, 2013)

SEIPS deliberately places people in the centre of the work system to emphasise the role of people within the sociotechnical system and that design should support – not replace or compensate for – people. The circular nature of the work system also highlights the complex (i.e., non-linear) interactions between system components.

What can SEIPS be used for?

The SEIPS framework is flexible and can be used in multiple ways. It can be a useful framework to use retrospectively as part of a patient safety incident investigation to understand the influence of system design on what happened in the past. It can also be used when designing a new care pathway, system or process to describe what outcomes could be in the future and how work systems might need to be designed to enable those outcomes.

Transfusion of ABO-incompatible blood component case study

We reviewed a completed Serious Incident report of an ABO-incompatible blood transfusion through a SEIPS lens to understand how SEIPS might be used in practice for exploring and structuring contextual factors in patient safety incident investigations.

Our review was limited to the information presented in the Serious Incident (SI) report, we did not have access to any additional information (e.g., interview or observations notes/transcriptions, statements, local policies). As such, we restricted our review to only consider the work system elements of SEIPS (person(s), tasks, tools and technology, internal environment, organisation, external environment). We did not consider the different process elements, outcomes, or adaptations (the right side of the SEIPS 2.0 model) since this would require further information gathering and understanding of the context. We did, however, speculate in our analysis below where additional information may have revealed further influences on the incident.

Understanding the context: timeline mapping

We initially compiled a timeline of the events that led up to the patient safety incident based on the description of what happened in the SI report. We then categorised descriptive information written about those events according to the work system elements within the SEIPS work system. Once categorised, we added context by layering in relevant information to each event described on the timeline. An example template for a timeline is presented in figure 2. By layering the information, we began to understand the context within which observable actions took place and started to understand potential interactions between different factors.

Figure 2. Example of how to add context to a timeline using SEIPS work system categories. Note, colours are taken from the work system elements of the SEIPS 2.0 model

While most investigations require the construction of a timeline to understand the story, timelines can impose a linearity to an event that only exists in hindsight. While any timeline template is useful for piecing together how an incident unfolded, layering the observable actions with context is key to understanding why actions made sense at the time.

Understanding interactions: SEIPS mapping

Our timeline mapping exercise, layered with contextual information, enabled us to start to determine some important contextual factors that required further unpicking. We first listed important contextual factors (see Table 1) and then started to map them using the SEIPS work system layout to explore interactions (see Figure 3).

Table 1. Contextual factors categorised according to SEIPS work system components. Note, colours are taken from the work system elements of the SEIPS 2.0 model. Factors not included in the original investigation report are noted in italics

Work system component	Context
External environment	• SHOT and DoH CAS (Central Alerting System) Alert recommended formal bedside checklist (Nov, 2017) *(reason not explored in the report)*
Organisation	• Unprecedented bed escalation issues resulting in admissions and bed movements continuing into the evening shift (resolved at 00:45) • Staffing: qualified nurse was on duty with a band 4 who was moved elsewhere and replaced with a band 2 'bank' member of staff unfamiliar with the environment • Staff from security team allocated to collect blood components over night • Previous business case for the purchase and implementation of electronic transfusion software was not progressed • Capacity to respond to emergency in a timely way – outreach in attendance at another emergency, on call team unable to attend once transfusion reaction identified
Internal environment	• Design of the blood storage area? (security guard reported blood was not on the allocated shelf indicated on the compatibility slip) – *not explored in the report* • Night-time: neighbouring patient complained of interruptions (bright lighting?) • Two patients with same surname, both requiring blood, allocated to the same ward (*unclear what actions/alerts were in place to reduce risk*)
Tools and technology	• Blood labels – handwritten, mislabeled • Observations for transfusion must be entered on both transfusion form and NEWS 2 form • Log-in issues: - transfusion nurse unable to login to computer system (verification check completed by nurse colleague instead) - Security unable to login to computer system (was locked out; had experienced issues previously) • Usability issues: green tick on computer system assumed to indicate a correct cross check of correct blood product with correct patient • Complexity and confusion with compatibility and collection slips *(not explored in the report)* • Commencement of syringe driver delayed due to availability of equipment • Formal bed side checklist not in place *(not explored in the report)*
Tasks	• Stickers available to identify patients with similar names not used (same person prepared blood for both patients) – *not explored in the report* • Collection of blood unit – complex task involving multiple paper cards (may pose difficulties for some members of staff less familiar with the process) – *not explored in the report* • Blood checks (reviewed appearance and surname, and entered component number on the computer system)
Person(s)	Patient • Not previously received blood transfusion – required crossmatch samples • Patient's name spelling? *(not explored in report)* • Patient did not want to be woken for third dose (01:52) Staff nurse • Competency was up to date • Personal circumstances *(specifics not described in report)* • Workload high – staff on catch-up Band 2 • Unfamiliar with the ward Security staff • Familiarity with blood collection? – *not explored in the report* • Competency was up to date

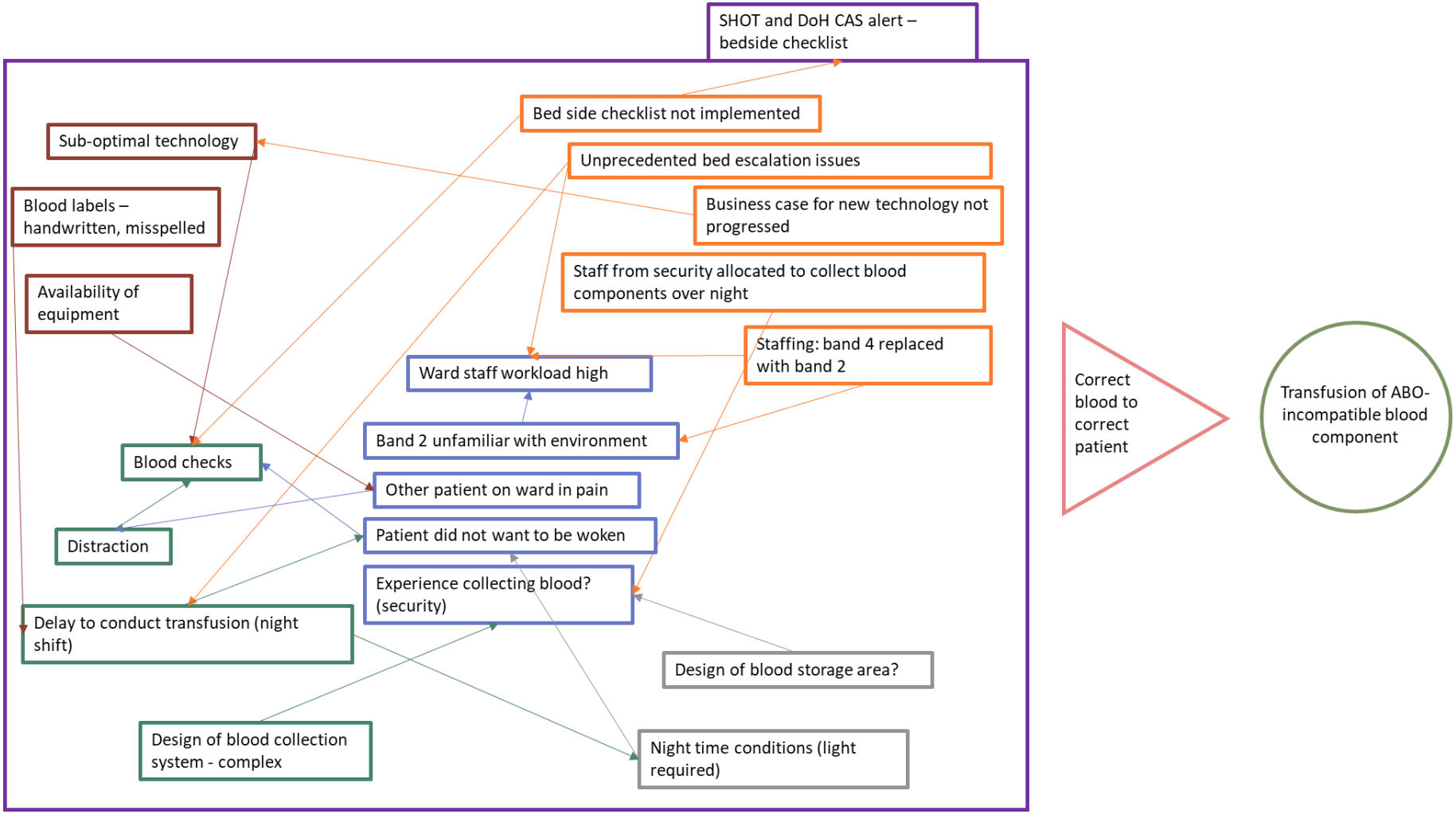

Figure 2. Overview of SEIPS work system analysis. Note, colours are taken from the work system elements of SEIPS 2.0

Findings summary:

The findings described below summarise the key influences identified in our analysis.

Delays to blood transfusion

Bed escalation issues (being unable to free up beds to admit new patients) contributed to a delay in administering the blood transfusion. The delay in transfusion meant that activities were conducted out of hours. The organisation's policy stipulated that security staff (who may be less familiar with the blood collection process) should collect blood components overnight.

Labels for transfusion sample tubes were handwritten. Misspelling the patient's surname on the label introduced a delay in the blood transfusion process.

Night-time conditions

Delays to administering the blood transfusion meant that the third unit of blood was administered late at night when patients did not want to be disturbed, this in turn impacted the blood checks conducted.

Bed-side checklist not implemented

A bed-side checklist recommended by SHOT via the Central Alerting System (CAS) had not been implemented by the organisation.

Workload and staff skill mix

Bed escalation issues led to a high workload for staff.

An experienced member of staff was replaced with a junior member of staff who was unfamiliar with the ward environment and less able to support the nurse.

Sub-optimal technology

A business case for new technology to support the transfusion process was not progressed leaving staff with sub-optimal technology. General usability issues including login problems impacted on staff ability to perform an appropriate double check.

Task complexity

Collecting blood units from storage is a complex task involving multiple pieces of paper (and was conducted by a member of staff who may be less familiar with the process).

The design of the storage unit potentially contributed. Although this was not explored in the SI report, it is stated that the blood was not found where the security guard expected it to be.

Distraction during administration

Equipment (syringe driver) was not readily available to administer pain medication to another patient on the same ward. This resulted in significant pain for the other patient causing a distraction for the nurse at the point of administration of the third unit of blood.

Same surname

The patient was transferred from Patient Admission and Transfer (PAT) suite to the Oncology Assessment Unit where another patient with the same surname was also awaiting a blood transfusion.

Although the same person prepared the blood for both patients with the same surname, stickers to identify similar names were not used.

Conclusions

Using SEIPS enabled us to highlight key contextual factors, including the complexity of the work system, which had previously been hidden within the narrative of the SI report. This gave a better understanding about the context surrounding the events leading up to the incident. Importantly, it enabled us to move away from cause and effect thinking by prompting the consideration of interactions between contributory factors that underpinned the incident. By using SEIPS and drawing a simple work system diagram it is easy to see the numerous interlinked systemic factors that contributed to the outcome.

The SEIPS findings outlined came directly from the original investigation report – no further information was sought. What SEIPS added was a new way to restructure the information that was described, and a new lens to view the information through. Importantly, the lens, while including people, looks at the wider work system and considers how these factors interact.

During our SEIPS review of the SI report we were able to identify a few important contextual factors that were not explored in the original report. These are highlighted in Table 1 in italics and include:

- Design of the blood storage area
- Complexity of the blood collection processes
- Use of stickers and other techniques to reduce risk when two patients requiring blood are placed on the same ward

While we used SEIPS after an investigation had been completed, ideally the framework should be incorporated throughout the investigation process including during the information gathering stage. For example, during interviews with those involved and during observations to guide what do look for.

While we have not included a review of the recommendations made, we believe that the application of the SEIPS framework could support more effective recommendation development as it is clear that there were several opportunities for system changes to reduce risk. This would also guard against recommendations that are often made in SI reports such as retraining, reflection and/or clinical supervision.

Work is currently underway to provide practical tools for using SEIPS in incident response. Other tools are also available:

- SEIPS 101 and seven simple SEIPS tools (Holden and Carayon, 2021)
- NHS Education for Scotland (NES) SEIPS worksheet | Turas | Learn (nhs.scot)

References

Carayon, P., Schoofs Hundt, A., Karsh, B., Gurses, A.P., Alvarado, C.J., Smith, M. & Brennan, P.F. (2006). Work system design for patient safety: the SEIPS model. *Quality & Safety in Health Care*, 15, i50-i58

Carayon, P., Wooldridge, A., Hoonakker, P., Hundt, A.S. & Kelly, M.M. (2020) SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Applied Ergonomics*, 84, 103033

Holden, R.J., Carayon, P. (2021). SEIPS 101 and seven simple SEIPS tools. *BMJ Quality & Safety*, 0, 1-10

Holden, R.J., Carayon, P., Gurses, A.P., Hoonakker, P., Schoofs Hundt, A., Ozok, A.A. and Rivera-Rodriguez, A,J. (2013) SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, 56(11), 1669-1686.

Meadows, D. (2009). Thinking in Systems. London: Earthscan