Investigations by acute-hospital staff: AcciMaps or HFACS?

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ABSTRACT

For many years the classical approach to healthcare incident investigation has been Root Cause Analysis (RCA). However, healthcare has faced increasing criticism for failing to learn from when things go wrong and for investigations that are ineffective. There is a need to better support healthcare staff, who may have limited training and experience in investigation, to undertake more effective patient safety investigations. The authors aimed to identify an appropriate and usable patient safety investigation method for use by healthcare staff. The result of a literature review and engagement with experts led the authors to focus on the Human Factors Analysis and Classification System (HFACS) and AcciMap. Prior to evaluating the methods, HFACS was adapted to the acute hospital context by developing a coding set based on the original codes. Through workshops the authors identified a clear preference for HFACS. Its prescriptive nature appealed to investigators in that it considered all aspects of their systems and highlighted the potential contributory factors; it was felt to have face and content validity. HFACS presents a much-needed prescriptive model for investigators from varying backgrounds and experience. It is usable, appropriate, valid and reliable. The HFACS codes may require further development for different contexts, having been developed here for acute hospitals.

KEYWORDS

Patient safety, incident investigation, safety science

Introduction

For many years the classical approach to healthcare incident investigation has been Root Cause Analysis (RCA), commonly following the ‘London Protocol’ (Taylor-Adams & Vincent, 1999). For several of those more recent years, healthcare has also faced criticism for failing to learn from when things go wrong and for investigations that are ineffective (Macrae, 2016; Mitchell et al, 2016). The result has been repeated incidents and a need for newer methods and tools to support effective incident investigation.

Patient safety, the area of healthcare often responsible for investigations, is in an unenviable position. Not only is patient safety difficult to achieve, capability and resource for undertaking investigations is often limited. Investigations are often undertaken by well-meaning staff with limited training and while trying to balance the investigation with their normal responsibilities.

For several years the Swiss-Cheese Model (SCM) (Reason, 1990) has often been quoted in relation to patient safety investigations. It has been the go to model for investigators. However, the SCM has been criticised for being difficult to apply to the real world and inadequately considers the complexity of the modern systems (Larouzee et al, 2020). Investigators, less familiar with the SCM, may also still rely on the use of simple, sequential methods of analysis that rarely get past the individuals involved.

There is a need to better support healthcare staff, who may have limited training and experience in investigation, to undertake more effective patient safety investigations and to move those investigations from an individual to system focus. To do this requires usable and appropriate methods to support analysis that focus on the system. The authors aimed to identify an appropriate and usable patient safety investigation method for use by healthcare staff. The study comprised of two parts: identification of methods via literature review and expert consensus, and evaluation of their use in a patient safety incident investigation.

Literature review

To identify potential methods for patient safety investigation, the authors undertook a review of the safety science literature. This identified several methods including the Systems Engineering Initiative for Patient Safety (SEIPS) (Holden et al, 2013); the Systems-Theoretical Accident Modelling and Processes model (Salmon et al, 2012); AcciMaps based on the structure of Rasmussen's Risk Management Framework (Rasmussen, 1997); the Human Factors Analysis and Classification System (HFACS) (Shappell & Wiegmann, 2000); and the Functional Resonance Analysis Method (FRAM) (Hollnagel, 2012).

To support identification of which methods were best to take forward in the study, the authors approached three experts in safety science who were familiar with investigation in healthcare and the benefits and barriers associated with the methods. SEIPS was described as a common method, but has been used more for proactive work (Faye et al, 2010) and is limited by guidance on its use. STAMP has been used in multiple industries, but less so in healthcare (Waterson & Chung, 2010); it is complex and requires extensive training, and there are no clear validity or reliability studies (Braband et al, 2003; Stanton, 2013). AcciMaps have been used widely and while there are questions about their validity and reliability (Stanton, 2013), they are easy to use, visual and regarded as useful (Trotter et al, 2014); an amalgamated and standardised model is available (Branford et al, 2009). HFACS uses the same components as the SCM and is therefore familiar to healthcare, with wide use including some in healthcare (ElBardissi et al, 2007; Diller et al, 2014); it is easy to learn, has been validated and is reliable (Stanton, 2013). FRAM was described as being very complex requiring a deep understanding (Stanton, 2013); it may overcomplicate the system (Belmonte et al., 2011; de Carvalho, 2011).

The result of the literature review and engagement with experts led the authors to focus on HFACS and AcciMap as two potential methods for healthcare. It was noted that limited research had explored their use by healthcare professionals themselves when undertaking patient safety investigations.

Methods

HFACS and AcciMaps

Prior to evaluating the methods, HFACS was adapted to the context where it was to be used (acute hospitals) by developing a coding set based on the original codes (Shappell & Wiegmann, 2000). The coding set is hierarchical with the codes and subcodes shown in figure 1. Below each subcode are a series of nanocodes, describing specific factors. The new nanocodes were developed with a national expert in HFACS who had developed nanocodes for mental health and was trained by the original authors. The codes were also informed by the other healthcare literature concerned with HFACS (ElBardissi et al, 2007; Diller et al, 2014).

The structure and method used for AcciMaps was that described by Branford et al (2009). This standardised model considers incidents at outcomes, physical, organisational and external levels.

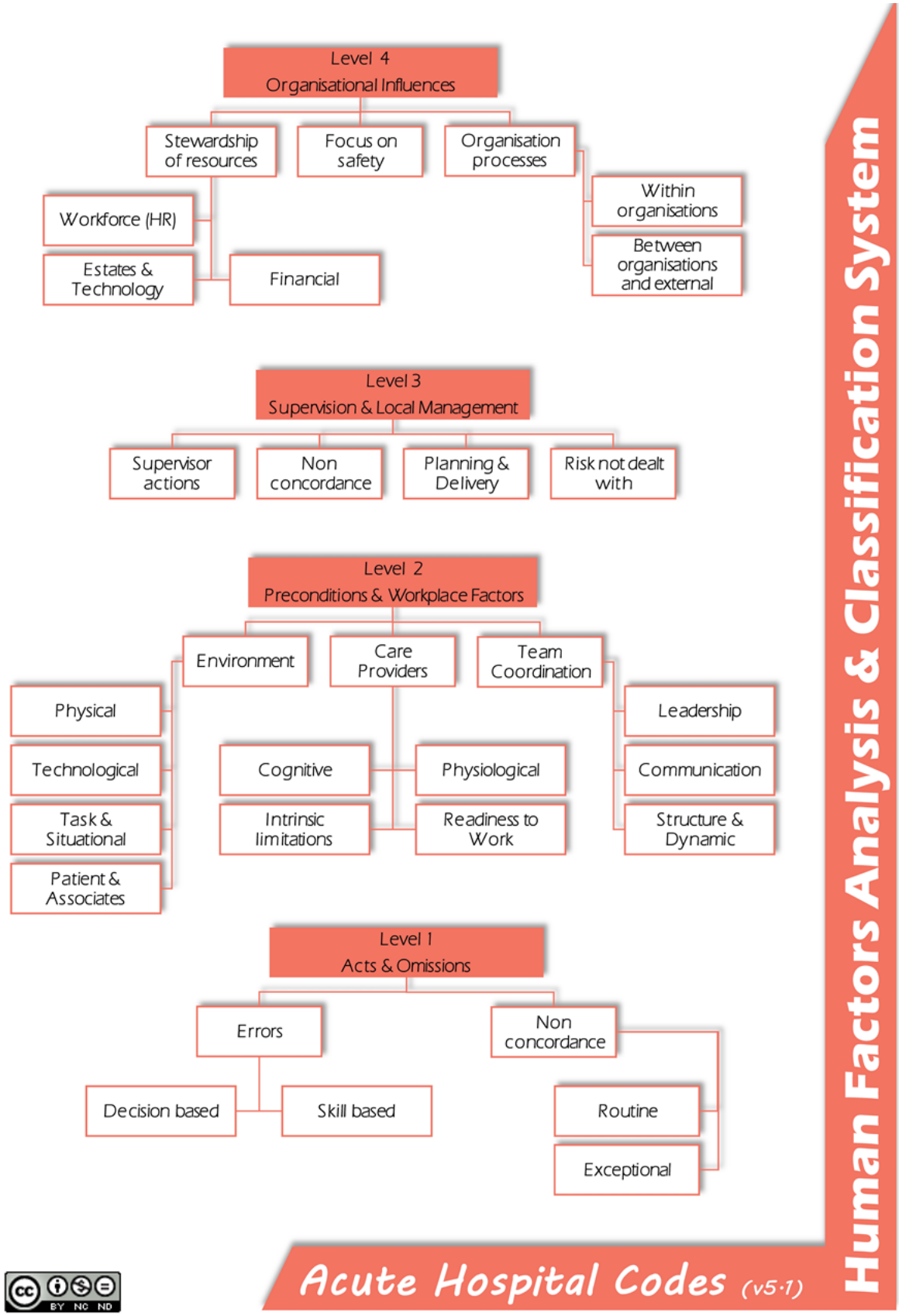

Figure 1: HFACS codes and subcodes used in the study and developed for acute hospitals

Incident investigation

Following ethical and research approval, the authors engaged with an acute hospital to identify participants and a relevant incident to apply the methods to. A significant harm incident was chosen by the hospital's Head of Patient Safety and was anonymised. The incident involved the incorrect route of administration of a medication and had multiple contributory factors.

An investigation of the incident was undertaken using both HFACS and AcciMaps by a variety of healthcare staff (the investigators). Analysis and investigator feedback explored method appropriateness to healthcare, method attributes, reliability and validity. The study sample (investigators) was drawn from a representative cohort of staff who would normally undertake patient safety incident RCAs. Investigators were recruited using a convenience approach until saturation was reached and no new findings identified.

Standardised workshops were set-up and run for the undertaking of the investigations. Following information and consent, investigators were asked to complete a baseline questionnaire. They then read the incident and were introduced to one of the two methods and asked to analyse the available information. Following completion, they were introduced to the other method and asked to re-analyse. After using both methods a further survey was completed. Due to the methods being presented and used one after the other, to minimise order bias, workshops were randomised with HFACS as the first or second method used.

Data was collected in the form of questionnaires with sections considering background and experience; usability and appropriateness (informed by Sheridan (2014)); and face, content and concurrent (with classic RCA) validity. Likert scales (strongly disagree (1) to strongly agree (7)) were used for ranked questions. For the most popular method, interrater reliability was analysed using Krippendorff's alpha (Krippendorff, 2004).

Results

Quantitative

58 investigators took part with the majority from a nursing background (n=42). Staff experience of RCA (M=5.14, SD=1.61) and human factors in healthcare incident analysis varied (M=2.31, SD=1.55).

34 investigators used HFACS as the first method and 24 used AcciMaps. 53 investigators provided a preference on method type with 73.6% (n=39) expressing a preference for HFACS, 18.9% (n=10) for AcciMaps and 7.5% (n=4) for a combination. Preference for a particular method was not associated with the first method used $\chi 2$ (2, N=53) =0.39 ρ=0.82.

Investigator provided their perceptions of HFACS: conciseness (M=4.30, SD=1.35); ease of use (M=4.79, SD=1.33); and ease of learning (M=5.19, SD=1.38); and for AcciMaps: conciseness (M=3.17, SD=1.46); ease of use (M=3.76, SD=1.82); and ease of learning (M=4.32, SD=1.70).

Regarding validity, investigators provided their perceptions on HFACS: considered all aspects of the system (M=5.65, SD=0.94), identified relationships and influences (M=5.16, SD=1.17), and was comprehensive (M=5.29, SD=1.09); and on AcciMaps: considered all aspects of the system (M=4.18, SD=1.59), identified relationships and influences (M=4.17, SD=1.61), and was comprehensive (M=3.79, SD=1.59).

HFACS was the most popular method. To assess reliability, seven strong contributors to the incident were identified by one of the authors from an independent and blinded (from the RCA) analysis of the incident. Inter-rater reliability was moderate for allocation of contributors (if identified) to HFACS and the subcode level (α=0.54).

Qualitative

Qualitative comments about both methods were positive with a feeling that they offered more than traditional RCA approaches. Consensus was that whatever is used needs to be prescriptive to support investigators.

Opinion amongst most investigators was that AcciMaps were confusing to create and interpret. A small number of participants felt that the visual approach was more appropriate for them and supported learning. It was recommended that better colour coding could be used to support exploration of contribution. AcciMaps would need facilitation to undertake and regular use to develop familiarity.

Opinion amongst investigators was positive for HFACS, with support for its prescriptive nature to prompt the investigator. It was felt that HFACS had a spectrum of complexity as staff could use all the nanocodes or just the codes and subcodes. It was felt that an electronic version could be useful. Concern was shared about the breadth of HFACS and when investigators should stop coding. The breadth also led investigators to feel that training would be difficult for the wide-ranging ability of investigators as familiarity was needed with the method.

Discussion

Healthcare has a debt to patients whom it avoidably harms. This debt is paid through the investigation of incidents and identifying learning to bring about change to reduce the potential for future incidents. Fundamentally, those investigators need the training, tools and time to undertake effective investigations. However, all of these are often lacking. This study has focussed on the tools by identifying an appropriate method for use by healthcare staff.

Selecting a single method is challenging (Leveson, 2011), particularly considering that over 100 different methods and models exist (Underwood & Waterson, 2013). In selecting methods, consideration needs to be given to factors such as training, focus, effort, clarity, output and ease of understanding (Underwood & Waterson, 2013), as well as considerations of validity and reliability.

This study identified two methods to focus on, following input from safety science experts and review of the literature; AcciMaps and HFACS. Both offered support to investigators and both were felt to be better than anything currently in healthcare. They therefore provide options to investigators who will have different preferences and the methods may be more or less applicable to different situations.

However, there was a clear preference for HFACS quantitatively and qualitatively. The prescriptive nature of HFACS appealed to investigators in that it considered all aspects of their systems and highlighted the potential contributory factors to acts or omissions; it was felt to have face and content validity. It was also felt to move the investigation beyond the individuals involved, away from the blame-focussed approach often seen in healthcare, to a more system-focussed perspective that shows the influence of organisations and external factors. HFACS therefore meets many of the expectations of a good method according to Underwood and Waterson (2013), but the authors acknowledge that some initial training and support to undertake investigations with HFACS is needed. Furthermore, the HFACS codes developed for the acute-hospital setting were found to be appropriate and valid.

The authors acknowledge several limitations with the study. The sample was self-selected with those attending being likely more engaged with the methods and willing to learn about new approaches. However, even engaged staff had limited time to allocate to this study and therefore due to time constraints only a single, retrospective incident was explored. Future work would benefit from considering live investigations and comparing methods proactively.

A further challenge, acknowledged by the authors, is whether HFACS is truly a systems-focussed method? Much like with the SCM, the literature presents various perspectives, and indeed the language used in HFACS and the linear/hierarchical nature of it may miss the complexity of the system (Larouzee et al, 2020). However, whether, academically speaking, HFACS is a system method or not is moot when it offers more than traditional RCA approaches in healthcare. In the future other methods, such as SEIPS may be more appropriate for healthcare and its use is increasing with various local and national bodies now using it.

Conclusions

Healthcare needs to consider alternative ways to extract learning from incidents. Both HFACS and AcciMaps offer more than current RCAs but are very different in their approaches to investigation. HFACS presents a much-needed prescriptive model for investigators from varying backgrounds and experience. It is usable, appropriate, valid and reliable. The method codes may require further development for different contexts, having been developed here for acute hospitals.

Future work should continue to develop the HFACS tool with the common types of healthcare investigators in mind, and their varying expertise. The method would benefit from comparison with other methods, such as the increasingly popular SEIPS, and during live investigations.

Supplementary material

Full HFACS codes, subcodes and nanocodes (available from the authors)

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