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## One event, three investigations

### The reproduction of a safety norm

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# One event, three investigations: The reproduction of a safety norm



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## ABSTRACT

Following an adverse event in a Swedish university hospital in 2010, three separate investigations seeking causal factors were conducted. We here review each of the analyses to see whether they together generate the kind of epistemological pluralism that could contribute to a systemic understanding of, and learning from, the event. Our content analysis shows that, while using vastly different amounts of time and resources, all three investigations make the same analytical choice to construct the causal factors as a deviation from norm in the event's immediate temporal and spatial proximity. We recognise that this both represents a strong discourse in the community analysing adverse events and seems to fulfil certain psychological purposes. Furthermore, we suggest that thorough analysis of adverse events in healthcare need to include aspects of system interaction from the micro to the macro, cognitive work configuration and design, as well as variability as a resource to harness rather than a threat to limit and control.

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## 1. Introduction

The discourses of healthcare quality and safety were merged through the convincing argument that healthcare errors should be an important focus for quality improvement. This argument, made by the Committee on Quality of Health Care in America in the report *To Err is Human* (Kohn et al., 2000), has since then guided efforts on patient safety (and quality) improvements in healthcare systems worldwide. Sweden is not an exception. For Swedish healthcare provider organisations, it is under certain circumstances mandatory by law ([The Swedish Patient Safety Act, 2010](#)) to report adverse events to the regulatory authority - formerly the National Board of Health and Welfare (SoS) and from June 2013 the Swedish Health and Social Care Inspectorate (IVO) - and also to conduct incident investigations themselves. For such investigations, methodological support has since 2005 been available from the Swedish Association of Local Authorities and Regions ([Swedish Association of Local Authorities and Regions, 2009](#)). Regardless of body responsible for analysis, identification of causes and prevention of recurrence are the major goals.

We have in two previous studies explored how Swedish healthcare provider organisations, in their internal investigations after adverse events, construct targets of intervention and system

improvement (Wrigstad et al., 2014), as well as how the Swedish regulatory authority's constructions of adverse events causation and targets of action has changed over the last 20-year period (Wrigstad et al., 2015). Together these studies draw a picture of how healthcare provider organisations, as well as the regulatory authority, construct causal factors to adverse events at the micro organisational level: close in both time and space to the adverse event itself.

Our epistemological starting point of analysis is that 'causes' of adverse events are not *found*; as if they were out there readily waiting to be discovered or uncovered. Our perspective is that 'causes' are *chosen* and *selected*; typically, by those given the mandate to choose and construct authoritative causal accounts (Rasmussen et al., 1990; Lundberg et al., 2010). Summarised as the WYLFYWF-principle (What You Look For Is What You Find) (Lundberg et al., 2009), our hypothesis is that if different bodies with differing public functions investigate the same adverse event, there is a possibility (or risk) that the different investigatory bodies explore, analyse and construct causal factors in different ways and further, that it would make them draw different conclusions and suggest different targets of intervention.

The field of Safety Science has since the 1930s developed several schools of thought in the construction of accident causation. The global healthcare safety community seems to owe much to Heinrich's theory of industrial accidents as linear chains of events, triggered by a root cause being either mechanical or (most often) human, and with a direct relationship between major accident

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consequences and minor accident consequences (Heinrich, 1931). Based in Heinrich's theorems of accident causation, measures such as incident investigations and searches for 'the root cause', become meaningful activities to safety enhancement efforts. It was much later that Turner introduced the idea that accident causation needs to be constructed in terms of organisational learning and information-sharing deficiencies over long time periods (Turner, 1978). This notion of how organisational learning and culture are at heart of accident causation was further developed by Vaughan (1996) and Snook (2000). Additional theories, introducing the notion of complexity, include Perrow's 'pessimistic' account of how tightly coupled and complex systems will always hold a catastrophic potential (Perrow, 1984), and the more 'optimistic' Rasmussian school constructing accidents in terms of dynamics and hierarchies (e.g. Rasmussen and Lind, 1981; Rasmussen, 1997; Rasmussen and Svedung, 2000). It is followers of the Rasmussian school of Safety Science who have introduced the notion of resilience, studying how people and organisations sustain operations by adapting to the various stresses and threats that their complex environments (often healthcare) face (Bergström et al., 2015; Wears et al., 2015; Hollnagel et al., 2013; Nemeth, 2007; Woods, 2005).

Given the broadness of perspectives on accident causation found in the literature, we are in this study interested in whether three different Swedish public investigatory bodies, with different purposes of analysis, conduct their analyses of the same adverse healthcare event in different ways. The research question is how a Swedish healthcare provider organisation (healthcare provider), its regulatory authority at the time, SoS, as well as the Swedish Accident Investigation Authority (SHK), respectively constructs and understands the causal factors leading up to the same adverse healthcare event. This specific adverse event is, to our knowledge and to this date, the only adverse event in Swedish healthcare that has been investigated by three different investigatory bodies at approximately the same time. Trusting the principle of epistemological pluralism (March et al., 1991; Healy, 2003), we believe that three different perspectives of the same adverse event could contribute to a systemic explanation and understanding of not only the system behaviour, but also of meaningful system interventions. In the following sections we choose, for simplicity reasons, to use the expression incident, as equivalent to accident, with the same sense and meaning as used in our previous studies.

## 1.1. Background

### 1.1.1. The adverse event

A severely ill patient with cardiac valve disease was admitted to the Department of Thoracic Surgery at a Swedish university hospital. The patient was scheduled for surgery to receive a mechanical valve-prosthesis. During the valve-replacement procedure on 12th of October 2010, an external pacemaker was placed to be able to stimulate the heart postoperatively, if necessary. After surgery, the patient was cared for in the Thoracic Intensive Care Unit (TICU). On the first post-operative day, the patient had an episode with grave cardiac arrhythmia and underwent successful cardiopulmonary resuscitation, otherwise the condition of the patient improved as expected. The stay in the TICU lasted in total four days, and plans were made to transfer the patient to a regular ward on the 17th of October.

In the evening of the 16th, a shortage of beds was upcoming in the TICU. A decision was made by the doctors on call on the TICU and the Cardiology Intensive Care Unit (CICU) to transfer the patient to the CICU as a so-called satellite patient. This meant that care was given by staff at the CICU, but the patient was formally under medical supervision by the TICU. On arrival at the CICU,

monitoring device for detection of arrhythmia was connected to the patient.

At a routine check by a nurse during the night shift the patient was found lifeless in bed. Resuscitation was attempted without any result, and the patient was declared dead. An autopsy was performed a couple of days later.

### 1.1.2. The incident reporting system

The Swedish healthcare system has since 1937 used a legislated model for external incident investigation of severe adverse events by a regulatory authority (The Social Welfare Board, 1940). The supporting foundation of this law states that if an adverse event has resulted, or could have resulted, in a serious incident, this should be reported to the regulatory authority for an external incident investigation. This model with a healthcare provider reporting incidents to a supervising regulatory authority has since then stayed virtually intact even though certain modifications, including name changes, have been made over the years. The regulatory authority has in recent years issued specific regulations governing the responsibilities of the healthcare provider; for example using an incident reporting system and carrying out internal incident investigations. In 2011 a legislative change pinpointed the healthcare providers' specific responsibility for patient safety *improvement* within their respective organisations. These regulations state that the regulatory authority "...ensures that reported adverse events have been investigated to a necessary extent, and that appropriate actions have been taken by the healthcare provider to reach a high level of patient safety" (SFS 2010:659). A new regulatory authority, IVO, was established in June 2013 (Prop. 2012/13:20) and commissioned to take over the supervision of the healthcare system from SoS. Both of these authorities act under the Ministry of Health and Social Affairs.

In general, the chief medical officer of a healthcare provider determines when and what to report to the regulatory authority regarding adverse events from the incident reporting system. A commissioning body within the healthcare provider is assigned to conduct an internal incident investigation. The commissioning body is most often the chief medical officer or the clinical head of department where the adverse event occurred. An analysis team is set up to perform the investigation and thereafter presents a report with recommendations on actions to the commissioning body. The external incident investigation by the authority is preceded by the internal incident investigation. In the external incident investigation the regulatory authority presents a decision to the healthcare provider addressing the fulfilment (or not) of their legislated role as previously stated.

SHK is an independent governmental authority under the Ministry of Justice that investigates all types of serious civil or military accidents and incidents with the aim of improving safety, regardless of whether they occur on land, at sea or in the air. Examples of areas where SHK carries out investigations include civil aviation, civil maritime transport, rail and road transports, as well as fires, building construction failures, mining, environmental pollution, nuclear power and medical technology. In some situations an investigation is mandatory while in others it is up to the authority to decide on the basis of the anticipated safety gains of an investigation. SHK is by the Swedish Accident Investigation Act limited to only target its recommendations to regulatory authorities. The adverse event studied here is, to our knowledge, the only incident in the medical field ever investigated by SHK.

### 1.1.3. The three investigatory bodies

- (i) The healthcare provider organisation (healthcare provider)

The chief medical officer of the healthcare provider assigned a commissioning body, the clinical head of department were the

adverse event occurred, and an investigation team was set up. The assignment for the healthcare provider's investigation team was to identify causes of the event, and find a routine that, if possible, avoids the recurrence of a similar event.

In this event, the investigation team consisted of 5 members of staff; 4 from the Department of Cardiology (includes CICU) and 1 from the Department of Thoracic surgery (includes TICU). The healthcare provider used the methodological support for conducting investigations provided by the Swedish Association of Local Authorities and Regions since 2005. The team leader had undergone internal training in incident investigation by the hospital. The explicit questions for the investigation team to answer were: (1) What happened? (2) Why did it happen? and (3) How is the recurrence of a similar event avoided?

The healthcare provider's investigation took 4 months to be complete and was presented in a 14-page report including a 3-page graphic layout with chronologically organised boxes showing defined minor events leading up to the adverse event.

(ii) The National Board of Health and Welfare (SoS)

The chief medical officer of the healthcare provider initiated the regulatory authority's external incident investigation by writing a report to SoS while the internal incident investigation was being completed. The assignment for SoS was to recognise if the healthcare provider had fulfilled their legislative obligation as described in Section 1.1.2. Thus, the guiding questions of SoS were: has the healthcare provider done enough to ensure that healthcare is both safe, of high quality and works best to serve its recipients?

The investigation team of SoS consisted of 1 inspector, 1 investigator and 1 head of unit at the regulatory authority. During the investigation, the team acquired expertise knowledge from a medical scientific advisor connected to the authority. SoS refer to 4 specific Swedish legislative regulations that form the base for their decision. The investigation took 24 months to complete and was presented in an 18-page report; 8 pages from the investigation team and 10 pages from the medical advisor.

(iii) The Swedish Accident Investigation Authority (SHK)

SHK initiated its external incident investigation as a self-imposed assignment with no particular commissioning body. In this investigation of an adverse healthcare event, SHK recommendations upon completion were, as legislation states, targeted to the successor of SoS, namely IVO as mentioned in Section 1.

The investigation team of SHK was composed of 3 members; 1 chairman, 1 team leader and 1 investigator in behavioural science. During the investigation, the team acquired expertise knowledge from 5 specialists; 2 in behavioural science, 2 in medicine and 1 in medical technology. The investigation by SHK should result in answers to three explicit questions: (1) What happened? (2) Why did it happen? and (3) How is the recurrence of a similar event avoided?

SHK's investigation took 33 months to be completed and was presented in an 81-page report.

A timeline of the duration for each of the three investigations is presented in Fig. 1.

## 2. Material and methods

Our study was conducted as a content analysis of three official, and on request publicly available, adverse event reports; all focusing on the same event. Following our research question (see Fig. 2), the content analysis had the following guiding questions: (1) How do the three investigation bodies construct causal factors of the adverse event in temporal and spatial spaces? (2) How do they, more conceptually, understand the adverse event? and (3) What perspectives were *not* taken, i.e. what narratives of adverse event-causation were *not* constructed as meaningful to guide future targets of intervention?

The claim that incidents need to be understood and constructed in spatial and temporal dimensions is raised in several of the schools of safety thought introduced in Section 1. Turner (1978) suggested already in the 1970s that incidents are preceded by an "incubation period". In Rasmussen's 'mapping' of incidents hierarchy and time forms the dimensions of causal construction (Rasmussen and Svedung, 2000). This approach is further used by Snook (2000) who uses these dimensions to show how complex organisations practically "drift" towards incident prone states. Further, sociologists like Vaughan has adopted a similar perspective focusing on deviance (from original norm) as a normalization process (Vaughan, 1996). More recently Dekker and Pruchnicki (2013) argued that such theorizing is still highly relevant. In our content analysis of the three reports on the adverse event the expression 'space' represents at what organisational level the causal factors are found and the expression 'time' represents how distant the causal factor is from the adverse event.

First, in order to identify the organisational level ('space') of the causal factor, we arranged codes according to a micro-meso-macro perspective (Cedergren and Petersen, 2011; Wrigstad et al., 2014, 2015). A causal factor at a micro organisational level is a factor identified within the department where the adverse event occurred, for example a local procedure, technical skills or staff issues. A causal factor at a meso organisational level is a factor that is identified outside the department where the adverse event occurred, for example the collaboration with another department or hospital management. A causal factor at a macro organisational level is a factor identified outside the organisation, for example the collaboration with another healthcare provider, authorities, politics or pharmaceutical companies. Second, to identify and code the distance in 'time' from the adverse event to a causal factor described in the incident investigations, we arranged a timeline (see Fig. 3) where "far" was the code for causal factors identified before admittance to the hospital, "close" was the code for causal factors identified from the admittance to the hospital until departure from the TICU and "very close" was the code for causal factors



Fig. 1. Timeline showing the duration of the three investigations.

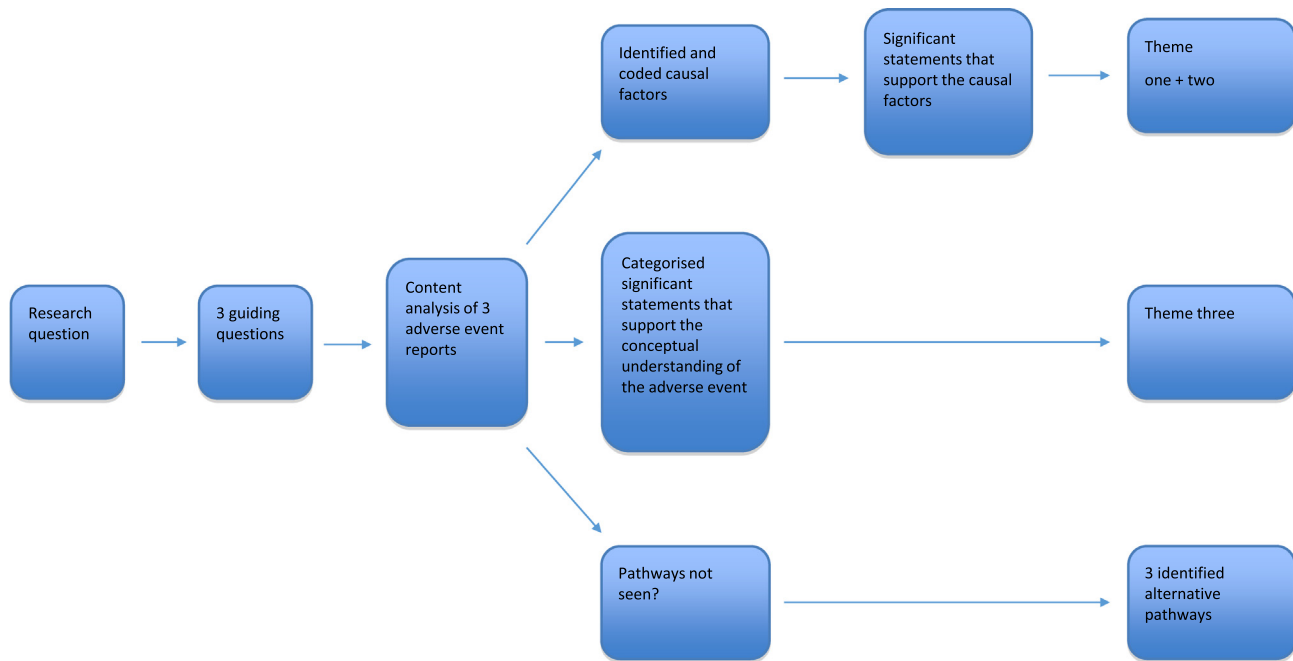


Fig. 2. An illustration of the method used in the study.

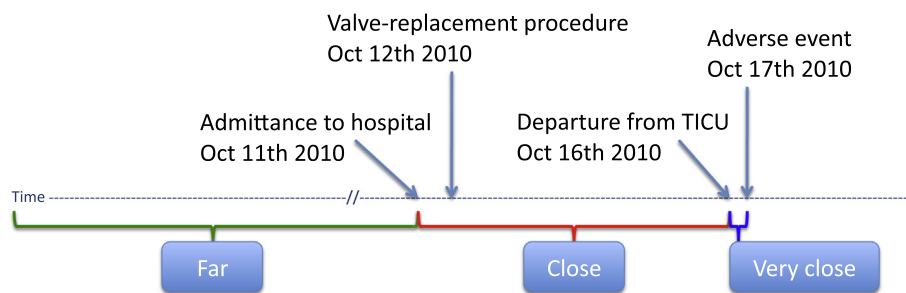


Fig. 3. Timeline showing the coded distance to causal factors from the adverse event.

identified from departure from the TICU until the adverse event occurred.

As shown in Fig. 2, in the first part of the content analysis (guiding question (1) we identified and coded all the causal factors from the respective investigation reports according to 'space' and 'time'. Thereafter we highlighted significant statements from the investigations that supported the construction of the causal factors. In the second part of the content analysis (guiding question (2) we highlighted and categorised significant statements that supported the conceptual understanding of the adverse event. Finally, as the last part of the content analysis (guiding question (3), we searched for pathways that the investigatory bodies tended *not* to see and were *not* taken when constructing the causal factors in accordance to the views given in Section 1.

All significant statements were thereafter thematised according to the first two guiding questions. Thus, the first guiding question resulted in themes one and two, whereas the second guiding question resulted in theme three. For the third guiding question three different alternative pathways were identified in accordance to theories mentioned in Section 1. The themes constructed and the alternative pathways identified through the content analysis are introduced in Section 3 (see also Fig. 2). The significant statements presented have been translated from Swedish to English by the first author and all are tagged with a number that represents an investigatory body.

### 3. Results

Based on a content analysis of the three investigations, guided by the questions introduced in Section 2, we defined three main themes of adverse event construction and three alternative pathways that could have better aligned the investigations with contemporary safety science (see Fig. 2).

The first theme is the construction(s) of the adverse event as one that occurred in the adverse event's immediate temporal proximity. The second theme relates to how all three investigations locate the causal factors as occurring in the patient's immediate spatial proximity. The third theme focuses on the underlying conviction that the adverse event represents a deviation from a safety norm.

The focus of the first alternative pathway is the possibility for an investigation to address the macro level of the Swedish healthcare system. The second alternative pathway relates to the possibility of studying normal work. The third alternative pathway deals with the possibility of an investigation to acknowledge and appreciate human adaptive capacity. We will in this section present the themes and support them by using some, out of a total of 35, significant statements from the investigations. Furthermore, we will present the alternative pathways and support them by raising several questions not asked in the investigations.

**Table 1**

Distribution of organisational level and distance in time from the adverse event in all of the identified causal factors from the three investigatory bodies. The letter in brackets represents the tagged letter after the significant statements under the different themes.

	Healthcare provider (A)	Distance	SoS (B)	SHK (C)	Distance
Macro	0		0	0	
Meso	<ul style="list-style-type: none"> <li>• Failure of hand-over between staff and departments</li> <li>• An absence of a formal routine and distinct responsibilities when transferring patients from one unit to another</li> </ul>	Very close	0	<ul style="list-style-type: none"> <li>• Failure of hand-over between staff</li> <li>• How patients in the satellite system were taken care of</li> </ul>	Very close
Micro	<ul style="list-style-type: none"> <li>• Not sufficiently enough nurses on the night shift</li> <li>• Staffs' know-how of the cardiac monitoring system, interpretation of the given data and temporary pacemaker treatment</li> </ul>	Very close	0	<ul style="list-style-type: none"> <li>• Routines and the usage of the cardiac monitoring system</li> <li>• Staffs' feasibility of giving surveillance to the patient</li> </ul>	Very close

### 3.1. Theme one: Immediate temporal proximity

The graphic layout from the healthcare provider's investigation defines the time that is investigated from the day of surgery until the fatal cardiac arrest; in total 6 days. The most extensive part of the investigation, where broken barriers and causal factors are identified, is from the transfer from the TICU to the CICU until death, with 9 of 13 boxes in the graphic layout covering this 6-h period. This converts to 2½ of the 3 pages in the report where the event is described, and where all 4 causal factors are identified, thus in the immediate temporal proximity of the event (see Table 1 and Fig. 3).

As stated above, the role of SoS is not to conduct its own investigation as much as it is to review and comment the investigation process of the healthcare provider. Consequently, the causal map of SoS regarding the timeline is identical to the causal map of the healthcare provider (see Table 1).

SHK's description of the adverse event is a time line that starts on the day the patient is admitted to the hospital and ends at the autopsy, thus approximately 10 days. When describing and framing the event 3½ of 4½ pages in the report comment on the time period of approximately 6 h from the transfer from the TICU until her death in the CICU. This is equivalent to the time period where all 4 causal factors are identified, thus in the event's immediate proximity (see Table 1 and Fig. 3).

### 3.2. Theme two: Immediate spatial proximity

Of the presented causal factors in the different investigations the first one presented in the healthcare provider's report and SHK's report are identical: failure of hand-over between staff (and departments). We coded this as a causal factor on a *meso* organisational level (see Table 1).

"A hand-over was made by telephone from a nurse at the TICU to nurse 1 on the evening shift at the CICU. The CICU nurse took handwritten notes on a piece of paper, since she was not able to report the patient directly to nurse 2 taking over the night shift as she was assigned to immediately transfer and give care to another patient on the way to an examination at the department of neuroradiology." (A)

"Nurse 2 on the night shift received the handwritten piece of paper with information of the TICU patient from nurse 1 on the evening shift. Since nurse 2 on the night shift wasn't able to take immediate care of the patient, she handed over the responsibility for this patient, and all of her patients, including the handwritten notes to nurse 3 on the night shift. Nurse 3 on the night shift knew nothing about the patient beside the handwritten notes she had received." (B)

"Because of the workload there was no time for a normal hand-over from the evening staff to nurse 1 on the night shift. There-

fore, nurse 1 on the night shift just took a brief oral report about the patients in her care." (C)

The system with so called satellite patients is an informal, but well-known, routine in Swedish healthcare to cope with recurring shortages of beds in different departments, intensive care units and wards. The second presented causal factors core message is also identical in the healthcare provider's investigation and SHK's: an absence of a formal routine and distinct responsibilities with the satellite system. We coded this as a causal factor on a *meso* organisational level (see Table 1).

"The physician on call at the TICU consulted his colleague at the CICU. They decided to transfer the patient to CICU since there was a need for cardiac monitoring. Care was supposed to be given as a so called satellite patient meaning that she still was under medical surveillance of the TICU, but care was given at the CICU." (A)

"Since there was a need for cardiac monitoring with the possibility to detect arrhythmia, the physician on call at the TICU made a judgement call that CICU was an appropriate intensive care unit in waiting for transfer to a ward at the thoracic department the next day." (C)

"When there was a shortage of beds at the TICU during the evening on the fourth postoperative day, it was decided to transfer the patient temporarily over night to the CICU for cardiac monitoring, before moving to a ward at the thoracic department the following day. A shortage of beds is unfortunately a recurring phenomenon in most organisations that involve thoracic surgery because of sudden emergency cases." (B)

Shortage of staff is a reappearing and well-known problem in Swedish healthcare. In the healthcare provider's investigation, this problem is identified and presented as the third causal factor: not sufficiently enough nurses on the night shift. The causal factor is supported, yet not stated, in the reports of the other investigations as well. There is no discussion in any of the investigations regarding shortage of staff being a problem in general and thus, this was coded as a causal factor on a *micro* organisational level (see Table 1). It should be noted that the ward was normally staffed during the night when the adverse event took place.

"When assistant nurse 1 on the evening shift was about to connect the patient to the cardiac monitoring device she was suddenly interrupted by the janitor who asked for help to transfer another patient going for an examination at the department of neuroradiology." (A)

"While nurse 2 on the night shift was away from CICU the workload was high for nurse 3 on the night shift. Beside the patients in her care other patients had arrived as well..." (A)

"The consequence of a high workload at the CICU was that assistant nurse 1 on the evening shift alone took immediate basic care of the patient upon the arrival from TICU..." (C)

“The staff situation seems to have been poor. This caused an unacceptable workload for some of the nurses as well as non-existing time to deal with the handover in an appropriate way.” (B)

Training and competence of staff is crucial for any healthcare provider with the ambition of maintaining safe healthcare. The fourth presented causal factor by the healthcare provider is merely identical to the third causal factor presented by SHK, the core message being: routines for staff regarding the cardiac monitoring system and its interpretation. This was coded as a causal factor on a *micro* organisational level (see Table 1).

“Interpretation of cardiac monitoring is an advanced task. (...) It takes years of clinical experience in combination with repeated training to accomplish competence in the field to guarantee a high level of patient safety.” (C)

“There is a lack of knowledge within staff regarding how the cardiac monitoring functions and interpretation of monitoring data including how a temporary pacemaker is used for treatment. Training of newly employed nurses and assistant nurses is continuously ongoing within the department, but there is no follow-up with repetition and testing over time.” (A)

“The responsibility lies on the nurse on the shift to check that monitoring is connected and verified correctly. It seems that this has not been fulfilled in this case.” (B)

An intensive care unit environment can often be a stressful workplace, a dynamic workload constantly changing, different alarms from different devices and sudden interruptions of work because of unforeseen processes. Therefore, the physical premises where the work is done and the location of control centres is of importance to maintain standard of care and staff's ability to work. The fourth presented causal factor by SHK identifies this: the staff's feasibility of giving surveillance to the patient. This was coded as a causal factor on a *micro* organisational level (see Table 1).

“When SHK performed individual interviews approximately half a year after the adverse event, staff said that no alarms had been detected from the patient. However, from the manufacturers' files one can find that four 'red alarms' actively have been silenced from the control centre...” (C)

“The monitoring alarm from 01.04 a.m. is disturbing and should have resulted in immediate contact with the physician on call.” (B)

### 3.3. Theme three: The event as a deviation from norm

We will here present and comment on a number of statements, where the core message is that the adverse event represents a deviation from a safety norm; a norm which the system could and should adhere to, through means of management structure and staff compliance. This presentation relates to our second guiding question from the content analysis. All the investigations shared the same conception of an underlying model as to why adverse events occur; a linear chain of events from a human root cause.

From all three investigations we conclude that work performance variability, i.e. degrees of freedom in how to conduct work at the staff level, is constructed as a threat to patient safety. Inherent in this idea is that there is one best practice for each task, and that any deviation from such best practice represents a violation and calls for increased formal structuring of work.

“From a management point of view, the daily practical work and work methodology has to a large degree been handed over to the employee's knowledge and experience. This includes the memorandums that have been created in the department without any formal approval.” (C)

“We look upon the event seriously and claim that the patient in this case has not been treated according to standard procedures during transfer to the CICU and during the stay at the CICU.” (B)

It's pointed out in the different investigations that staff needs to be more vigilant and focused when giving care to the patient.

“When a patient has a temporary pacemaker certain precautions should be taken since it means an increased risk, partly because of the ability of the monitoring system to sufficiently alert and partly because a temporary pacemaker needs specific routines that were not carried out during the night shift. In this case there was an increased risk that there would not be an adequate alarm from the monitoring system since it was not connected appropriately.” (A)

“Assistant nurse 1 on the evening shift, who was aware of the patient's pacemaker, obviously did not check that assistant nurse 2 on the evening shift had marked this important information.” (B)

Inherent in the idea of the accident representing a deviation in an inherently safe (if only complying with the norm) system, is also the 'Heinrich-ian' and dualistic search for causal factors at *either* the level of unsafe human behaviour *or* malfunctioning technology. Consequently, the potentially complex interaction between humans and technology is not discussed at all in any of the three reports. SHK's investigation identifies that during the period 2006 to 2012 there has been 17 reported adverse events into the hospital's incident reporting system related to “cardiac monitoring” in this CICU. Instead of constructing this as a problem of human-machine configuration and interaction, the investigations are satisfied with concluding that no defects have been found in the monitoring system after examination by the manufacturer. The SHK investigation notes that the full Swedish instruction manual comprises 366 written pages.

“No faults have been recognised in the technical equipment according to the manufacturer, meaning it has worked as intended.” (C)

“The technical device has functioned without any faults and the missing alarm was due to the fact that pacemaker detection had not been marked.” (B)

The reports acknowledge how the staff was coping with time pressure, a perceived shortage of staff and an increased workload during the work-shift. However, rather than analysing staff behaviour as a product of this environment, all three reports make the analytical choice to fundamentally attribute the unfolding of events to staff behaviour rather than the work environment. Again, the idea is that staff members could, and should, work according to a safety norm that would not have allowed the adverse event to take place:

“In this case the impression is that formal handover was done too quickly. There was not even time to give the compulsory oral report and instead a handwritten piece of paper with notes on a new patient was handed over.” (B)

“The CICU had no established system for formal handover supported by a checklist. (...) According to SHK, it is obvious that the absence of a formal system for handover in a setting like the CICU's with advanced intensive care can be a patient safety risk.” (C)

### 3.4. Alternative pathway one: Addressing the macro level of the Swedish healthcare system

The two identified causal factors on the meso organisational level are identical, as regards the core of interest. First, there was

a failure in communication between staff and between the intensive care units when the patient was transferred. Second, there were insufficient guidelines when transferring a patient between the two current intensive care units. We believe that an event like this gives opportunity to formulate much more systemic explanations of adverse events. Additional questions, targeted at the macro level of the Swedish healthcare system, includes:

- Do healthcare staff recognise negotiating the occupation of bed spaces between wards to be an intricate part of their work life?
- Is limits to ICU beds a generic problem in Sweden? And if so:
- For how long has limits to ICU beds always been a problem in the Swedish healthcare system?
- How did this problem emerge? In what political environment? In what (perhaps gradual) structural change of the Swedish healthcare system?
- What makes an informal routine with satellite patients a reasonable solution?
- What makes the solution to move a patient to a resource constrained CICU preferable to keeping the patient in an overcrowded TICU or sending the patient, who's condition had not changed at the time, just a few hours earlier than initially planned, to a ward tightly coupled to the TICU, and that on a daily basis receives these kinds of patients with exactly this monitoring? The fact that transfer of the patient to the CICU was perceived as the best option must prove that it was reasonable to do so, but what system structures and relations made it so?

### 3.5. Alternative pathway two: The possibility to study normal work

In a seemingly dualistic manner none of the investigations found any defects of the matter (the monitoring system), and hence looked for the defects of the mind (human behaviour). Both the healthcare provider and SoS present a similar scenario on the micro organisational level with inadequate technical skill of the staff in cardiac monitoring and not adhering to procedures in surveillance of the monitoring system. SHK, with vastly more resources put into their investigation, comes with a similar causal construction. SHK recognizes numerous reported adverse events from the past focusing on human-machine interaction. Still, their report focuses mainly on insufficient management and controlling of staff. We see this as a lost opportunity to analyse how human and machine actors are configured in their working environment. An analysis of the implementation of, and relation to, technological devices, interfaces and functions could reveal sources of brittleness and resilience not only of this hospital but perhaps the Swedish healthcare system as a whole. Our second additional pathway includes the following questions:

- Why does cardiac monitoring (devices) have to change at all when a patient is moved from one intensive care unit to another, especially within the same organisation?
- What is the process for implementation of technological equipment?
- How is this cognitive system of humans and technology configured? How does it coordinate its actions to achieve its purpose? Are there recurring unintended (and undesired) consequences such as coordination failure, alarm fatigue, or automation surprises?
- Is it reasonable to believe that 350+-page manuals regarding complex monitoring equipment are read and understood by all intended users?
- How can cognitive work analysis become a part of the process to implement new technology to Swedish healthcare working environments?

### 3.6. Alternative pathway three: The possibility to acknowledge and appreciate human adaptive capacity

Among the three investigations, SHK seems to avoid making direct judgement calls on the role of staff. However, the focus of analysis is still on the unreliable and risky staff behaviour. While the countermeasures suggested by the healthcare provider are targeted to working procedures and staff behaviour, SHK targets SoS in stating that the authority needs to ensure that the healthcare provider implements, and adheres to, a safety management system. Ultimately, in all three investigations the individuals fail to adhere to safety standards and norms. In none of the investigations adaptive human behaviour is seen as a valuable resource with the ability to adjust and adapt to risky, messy and complex situations. Instead, humans are constructed as a problem to manage and control. We encourage an analytical shift of focus into one that acknowledges how human action and agency as a vital resource to harness in complex and variable working environments and even how human adaptive capacity sometimes (perhaps in this case?) can work to 'hide' system brittleness. Thereby, this event offers the possibility to ask the following questions:

- Do staff members at the involved units believe that organisational levels higher in the hierarchy understand the difference between work-as-imagined and work-as-done (see [Patterson et al., 2006](#))?
- Do staff members perceive that they, within their 'margins of manoeuvre' (see [Woods and Branlat, 2011](#)), have the degrees of freedom necessary to adapt to the dynamic environment in which they are configured?
- To what degree do members of staff at the different units involved perceive that they are appreciated for the work they do?
- How much of their work do staff members perceive to be adaptation to situations that are not part of a prescribed routine?
- What is the stress level as perceived by the staff at the involved units?

## 4. Discussion

The adverse event in focus of this study represents one of the most thoroughly investigated in Swedish healthcare history. It is the first healthcare case to ever attract the attention of SHK. The main focus of our study was to examine if a parallel dissection of the three investigations would reveal an epistemological pluralism that could generate a systemic understanding of the event and thereby serve as an indicator of a way forward when learning about safety from events, or experience, in history ([March et al., 1991](#)). This could be expected, given the differences in resource availability for the investigations, the different targets of recommendations for the different investigation bodies and the different societal roles they play in the healthcare system.

However, rather than a study of the different ways in which three different public investigation bodies contribute to the knowledge of how patient safety is compromised, we were struck by the extent to which the three investigations share the same assumptions on how an adverse event represents a deviation from system norm which is built up in the event's immediate temporal and spatial proximity. In other words, instead of drawing a broader picture of the adverse event the different investigations confirm each other's findings when acting according to regulations. Perhaps this should not be seen as surprising, though. For investigations conducted by healthcare bodies we have seen this tendency to locate adverse event causation close in time and space of the event itself ([Wrigstad et al., 2014](#)). [Cedergren and Petersen \(2011\)](#) made similar observations of SHK's construction of factors contributing to adverse events in the railway domain. In the way the incident



reporting system is constructed in this healthcare system a completed incident investigation by a healthcare provider organisation will always be a main source of information for the upcoming authority investigation(s) and thereby possibly framing and guiding the understanding of the event. However, having a main source does not rule out the opportunity of any authority to broaden its sources of information regarding an event by, for example, performing on-spot inspections where the event occurred, using an alternative adverse event causation model or widening the perspective by expanding on background information through more and various accounts related to the event.

According to Dekker (2014a–c) incident investigations provide meaning by fulfilling four psychological purposes: (1) epistemological explanation of *what* happened linking causes to effects, (2) preventative explanations of how to avoid similar events to reoccur in the future, (3) moral explanations drawing the boundaries of behaviour for a profession (in a vocabulary typically dressed up as epistemological) and (4) existential explanation helping us to cope with the suffering of how even the systems institutionalized to cure can cause us harm. Our observation that a safety discourse, which makes three different public bodies in their investigations of the same event choose highly similar causal constructions, seems strong in the adverse events prevention-domain, can perhaps be explained by how effectively they meet the four purposes of incident investigation as introduced here. Summarizing all four psychological purposes: The three investigations allows for us to move on, ensured that suffering stems from unreliable human behaviour in systems that only require more structured control. Further, as Foucault (2002) would argue, a discourse determines not only what *can* be stated (in terms of causal factors of adverse events in healthcare), but also what *cannot* be stated. Consequently, we focused parts of our analysis on what perspectives that *were not* taken, and what narratives of adverse event-causation that *were not* constructed.

While we acknowledge how all three investigation bodies write accounts that make them satisfy the psychological purposes of incident investigation we still see them as a missed opportunity to embrace more complex epistemologies and diverse accounts of the event. Answering the questions from our first alternative pathway would require a broader analysis in both temporal and spatial scope. It would require studies of the structural as well as functional organisation of the Swedish healthcare system and the relationship between functions such as primary care, general internal medicine, intensive care and surgical care. It would further require a study of how the current state of affairs in the Swedish healthcare system has been configured by political and professional decisions made perhaps over decades. Such examples do exist in the history of adverse event investigation. For instance, the board investigating NASA's second loss of a space shuttle; Columbia, introduce one of their chapters in the following way:

“The causal roots of the accident can also be traced, in part, to the turbulent post-Cold War policy environment in which NASA functioned during most of the years between the destruction of Challenger and the loss of Columbia. The end of the Cold War in the late 1980s meant that the most important political underpinning of NASA's Human Space Flight Program – U.S.-Soviet space competition – was lost, with no equally strong political objective to replace it. No longer able to justify its projects with the kind of urgency that the superpower struggle had provided, the agency could not obtain budget increases through the 1990s. Rather than adjust its ambitions to this new state of affairs, NASA continued to push an ambitious agenda of space science and exploration, including a costly Space Station Program.”

[Columbia Accident Investigation Board, 2003, p. 99]

The questions asked in Section 3.4 could possibly guide an analysis towards similar causal factors of the adverse event studied here.

Additional (scientific) studies of adverse events as configured in a hierarchy from the sharp end-operations to the political level, and over a long period of time, include Snook's account of a friendly fire incident over northern Iraq in 1994 (Snook, 2000) and Vaughan's comprehensive analysis of the cultural environment of production contributing NASA's first loss of a space shuttle, Challenger (Vaughan, 1996). Further analytical language could be provided by Cook and Rasmussen (2005) who have provided a dynamic model discussing the behaviour of a “solid” healthcare system in which the coping resources and buffers are exhausted.

Looking at the second alternative pathway, the investigations studied in our analysis pictures a fixed technological environment for which humans need training and motivation to fit. Our questions above, on the contrary, suggest an analytical possibility that the joint cognitive working environment is configured in a way that makes the synchronising of functions, and activities between human agents and technological agents, inherently prone to regularly produce unexpected results and conditions. SHK does recognise that there are 17 reported adverse events related to “cardiac monitoring” in this CICU alone; but does not open up for the possibility that this says something about an inherently risky configuration of a working environment.

Also this alternative analytical pathway would rest on an extensive research base of how to design and understand joint cognitive healthcare working environments (Cook and Woods, 1996; Woods, 1995; Schmid et al., 2011; Raymer et al., 2012; Raymer and Bergström, 2013; Klein et al., 2004; Hollnagel and Woods, 2005).

The questions in the third alternative pathway emerge as a consequence of the different causal factors presented in the investigations that all seem rooted in the logic that variability is a problem to control rather than a resource to harness (to paraphrase Dekker, 2014a–c). Again, there is literature suggesting that not only risk is a result of system variability; so is safety (Cook and Woods, 1994; Dekker, 2014a–c; Hollnagel, 2014; Hollnagel et al., 2013). Understanding adverse events as unexpected products of normal (and ‘normal’ typically complex and dynamic) work allows for an analysis that not only can allow itself to go beyond easy targets of erroneous behaviour, but also opens up the ethical discussion of what working conditions and environments that could be accepted (Bergström et al., 2015).

## 5. Conclusions

We have here provided an analysis of how three different public bodies analysed the same adverse event that occurred in a Swedish hospital. We have recognised how they, while spending vastly different amounts of time and resources, all make the same analytical choice to construct the causal factors of the event, as a deviation from norm in the event's immediate temporal and spatial proximity. Further, we have suggested that this strong discourse prohibits more complex constructions of the adverse event as a symptom of the structural and functional configuration of Swedish healthcare, as developed over several years, or of how humans and their technology are configured in their working environment. Finally, we suggest that this strong discourse seems to fulfil psychological purposes for an organisation to move on after an event while at the same time it ignores contemporary research suggesting that variability is not only a source of risk to be controlled, but also a resource that makes a Swedish healthcare organisation at all function in the complex and dynamic environment in which it is configured.

We do recognise that the three investigation bodies studied find themselves, and what causal constructions that they can formulate, configured in a wider political and societal system with legislated boundaries that frame their ability to act respectively. Hence, a discussion regarding incident causation model used and additional questions to be asked in the wake of adverse events in healthcare cannot avoid a political dimension. We believe that such a societal discussion is necessary in order to go beyond moral stories of deviation from norm in the event's immediate temporal and spatial proximity.

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