Socio-Technical Safety Investigations in Healthcare – Investigating Human Performance in Modern High Reliability Sector Organizations

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Abstract. The introduction of the Healthcare Safety Investigation Branch into the National Health Service (NHS) in England is a world first, independent, not for blame investigation approach for healthcare. These investigations are conducted in an environment which has vastly varying levels of socio-technical complexity across a wide geographical region of the United Kingdom (UK) and across Trusts, departments and specialist disciplines. At the heart of this system are the healthcare workers who constantly balance resource to ensure patient safety is maintained to the highest levels. Embedded in a socio-technical system, the human contribution is often providing the adaptability which makes the system work. Historically if patient safety was compromised, or an unexpected outcome occurred it was the human contribution which was scrutinized, often with a view to disciplinary or punitive action in order to prevent recurrence. A more modern approach to system thinking guides us to see the human contribution as only one element of a socio-technical system and possibly the richest source of evidence for fully understanding any event. This pilot study has identified the perceived qualities deemed most valuable for healthcare safety investigators for whom the investigation of human performance will be key to understanding the majority of patient safety events they respond to. Non-technical skills including communication, Emotional Intelligence, resilience and empathy were ranked above the clinical or technical skills as more important for the individual investigator conducting investigation in healthcare. This is dependent on the clinical and technical expertise being available at a team level to the individual investigator. The initial findings are interesting in that they appear to indicate that as the environment is becoming increasingly socio-technically complex, it is the softer, non-technical (human-centered) skills that are required to understand narrative and context when unexpected outcomes occur in the healthcare setting.

Keywords: Healthcare · Safety investigation · Socio-technical · Human performance

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D. Harris (Ed.): HCII 2019, LNAI 11571, pp. 76–91, 2019.
https://doi.org/10.1007/978-3-030-22507-0_7

1 Introduction

The fast pace of technological advancement in society is clearly evident across many parts of the world in the 21st century. Over the past 80 to 100 years significant industries including commercial aviation, Air Traffic Control (ATC), healthcare and patient safety, power generation, financial markets and food production have become almost completely reliant on technology for their day to day transactions and management. As these industries have developed, the only real constant throughout has been the presence and influence of humans somewhere in the system. The human contribution is integral to making the overall system work and will include advancement and management of the technology, including the initial development of processes and systems to manage the Human Machine Interface (HMI), or Human Computer Interface (HCI). The working environments or work space that many of these humans occupy has morphed, from an almost simplistic, mechanistic workplace in to a complex socio-technical environment where humans are embedded in systems as agents alongside the technology (Stanton et al. 2010); the human while interacting with the technology is also often balancing resources, time, finances and even safety to provide flexibility and adaptability, this ensures the goals of the organisation are met (Hollnagel 2009). Such systems, composed of human agents and technical artefacts, are often embedded within complex social structures such as the organisational goals, policies and culture, economic, legal, political and environmental elements (Qureshi 2007). Socio-technical theory implies that human agents and social institutions are integral parts of the technical systems, and that the attainment of organisational objectives are not met by the optimisation of the technical system, but by the joint optimisation of the technical and social aspects (Trist and Bamforth 1951). Healthcare and patient safety, which is the main topic addressed in this paper is a good example of a modern complex socio-technical system. The technological artefacts (life support systems, ambulances, staffing and management technologies, robotic surgery, scanners, smart phones, tablets, communication systems and electronic health records for example) all play an essential role alongside the human agents in the functioning of the system as a whole.

The Socio-technical environment in healthcare is not standard or easily defined across all of the many specialist areas and disciplines - some of the specialist areas within healthcare might be considered to be very tightly coupled and very complex, whereas other might be loosely coupled and much simpler to describe. (Hollnagel 2009). The social/technical environment exists across all of healthcare however, therefore the behaviours and interactions/interventions of the human agents are key to the overall day to day management of this system. As technology became integral to many of the industries already mentioned (including healthcare), rules and procedures had to be developed to give order and structure to the environment and guide the tasks or processes, the aim being to improve productivity and achieve an outcome. More latterly in these industries we now see risk management processes employed in order to enhance safety, and safety regulation then appears alongside efficiency and thoroughness as competing goals (Hollnagel 2009). Operating procedures, rules and even laws were designed and implemented to direct the human and technical contribution, these procedures and rules at the local level were often introduced by management and decision makers far removed from the actual work being done, resulting over time in a clear gap between work as imagined by the management and designers, and work as done by the workforce closest to the day to day activity (Snook 2000). This gap also often being exasperated by rules, procedures and laws imposed from outside of the organisation i.e. government, regulators and professional bodies set up to represent and monitor professional standards within certain disciplines.

2 Background

When accidents occur in the modern socio-technical environment, they often occur as a result of the normal and expected interaction between the humans, the technology, the procedures, the environment and the equipment. An interaction which normally does not result in any negative outcome has, despite outwardly appearing to be the same as previous interactions, resulted in harm. Traditional accident modeling approaches are not adequate to analyse accidents that occur in modern socio- technical systems, where accident causation is not the result of an individual component failure or human error (Qureshi 2007).

In a time preceding the complex environment we now operate in, the cause of any mishap was often thought to be simple and clear; something mechanical or technical broke, a worker was negligent or was not following rules and procedures or was criminal or malicious. An investigation would quickly find the root cause. Equipment could be mended, replaced or subjected to better design or maintenance regimes. The worker could be dealt with through, retraining, blaming, shaming, discipline or dismissal. For the investigator in these early days the method of investigation was also quite simplistic. The investigator was reliant upon the accident causation models, theories or approaches available at the time, these models were devised from academic research for use in the applied setting, based upon the known complexity at that time. Accident models provide a conceptualisation of the characteristics of the accident, which typically show the relation between causes and effects. They explain why accidents occur and are used as techniques for risk assessment during system development and post hoc accident analysis to study the causes of the occurrence of an accident (Qureshi 2007).

Linear logic was employed to analyse the event (often in the early days only the immediate event) and once the component parts had been identified an almost mechanistic approach was employed in order to demonstrate cause and effect linkages. This cause and effect linkage was mostly temporal, i.e. Action A preceded Action B in time, which then resulted in the event under investigation. Action A may have been identified as the root cause and therefore recommendations would then be drafted to deal with whatever shortcomings were evident at Action A. These analysis methods, referred to as sequential methods evolved over time to include for example; “Root Cause Analysis (RCA)”, 5 Whys, Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Sequentially Timed Event Plotting (STEP). In the time-line of safety investigations, this approach was dominant in many high reliability organisation investigations right up until the modern day, though most began a move away from these as their prescribed method by the early 1980’s. It should be noted however that one of the strengths (and weaknesses) of this type of linear approach, is the ability to create accurate timelines focused on the period proximal to the identified outcome, thus quickly establishing what happened and who or what was involved at that point. This approach does not adequately address how or why we arrived at the outcome - this being a crucial part of the event under analysis if we are to make recommendations to prevent recurrence. With this limitation in mind and following a number of serious industrial accidents with what appeared to be an organisational focus e.g. Three Mile Island, Bhopal and Chernobyl a new approach was required to adequately explain events. Simplistic linear methods did not necessarily capture the performance shaping factors of the workplace, organisation or environment and new approaches and thinking on behalf of the investigator would be required in order to do so. The need for more powerful ways of understanding accidents led to the class of epidemiological accident models, which began to gain in popularity in the 1980s.

This analysis approach came to prominence in the late 80s. One model aligned with this theory and conceptualised at this time is the well known but colloquially named Swiss Cheese Model, established by Professor James Reason (Reason 1990). Complex linear thinking with regard to accident investigation was considered to be the new approach required in order to get beyond the proximal event and begin to address the how and why of the accident. By working backwards and examining actions and events beyond the immediate, front-line we begin to address those elements which though not proximal to the outcome demonstrate a potential to affect the outcome. Reason referred to these as latent causal factors to differentiate them from the active areas previously focused on. Reason draws attention to "The significance of causal factors present in the system before an accident sequence actually begins… and all man-made systems contain potentially destructive agencies, like the pathogens within the human body".

Epidemiological models regard events leading to accidents as analogous to the spreading of a disease, i.e. as the outcome of a combination of factors, some manifest and some latent, that happen to exist together in space and time. Reason's (1990) Latent conditions including management practices or organisational culture are likened to resident pathogens and can lie dormant in a system for a long time. Reason referred to this approach as a total systems approach to safety although, as we will see with the systemic models that will follow in this timeline of approaches, the total system (outside of the organisation or institutions thought to be directly involved) may not have been adequately represented in these early "Epidemiological" types of investigations.

Reason based epidemiological approaches to investigation have been adapted by many industries and domains in order to best reflect the specific nuances of the organisations where an accident or serious incident has occurred - the Australian Transport Safety Bureau (ATSB) model (ATSB 2007) is one such approach others include HFACS (Wiegemann and Shappell 2003) and the Accident Route Matrix (Harris et al. 2016).

In a complex dynamic environment it is not possible to establish procedures for every possible condition, in particular for emergency, high risk, and unanticipated situations (Rasmussen 2007). Decision making and human activities are required to remain between the bounds of the workspace defined by administrative, functional and safety constraints. Rasmussen argues that in order to analyse a work domain's safety, it is important to identify the boundaries of safe operations and the dynamic forces that may cause the socio-technical system to migrate towards or cross these boundaries (Qureshi 2007). These boundaries; acceptable behaviour, safety regulation, economic failure and unacceptable workload form the edges of the space within which work as done (as opposed to work as imagined) is completed. Workers are constantly adapting their behaviour, processes and methods in order to meet the output requirement of their dynamic environment. Often this adaptation occurs within the safe space bounded by the four factors listed above, however if this adaptive practice crosses the boundaries of acceptable behaviour and safety regulation this may lead to a loss of control and an accident may be the result.

The sequential and epidemiological models have contributed to the understanding of accidents; however, they are not suitable to capture the complexities and dynamics of modern socio-technical systems. In contrast to these approaches, systemic models view accidents as emergent phenomena, which arise due to the complex and nonlinear interactions among system components (Qureshi 2007).

One common theme for all of the analysis concepts and approaches listed above, is that they set out to de-construct an event, situation, accident sequence or near miss, with the aim being to establish causal links. Some of these links will be proximal to the event while some, such as government policies and governing body direction, will be far removed. The investigator will plot the agents and artifacts involved (in their initial time-line of the incident), then aim to identify where any cause and effect, or lines of influence might be evident (findings based upon analysis). The most up to date systemic methods purport to be non-linear and complex in their approach, however there is still almost always a temporal order required to establish a cause and effect relationship. Is this cause and effect linkage even required in a socio-technical system in order to adequately de-construct the event?

If the aim of a modern safety investigation is not to apportion blame or liability but to prevent recurrence, learn lessons and make the system safer, is there any requirement to establish cause and effect linkages at all? A more pragmatic approach to understanding patient safety events in healthcare for example might be one of getting the whole story, understanding the complete context behind actions, decisions and behaviours in order to determine why people's actions made sense to them at the time, rather than isolating them in order to place them in some perceived order for understanding. We are then looking at human performance investigations whereby the mechanistic, simplistic and even the more complex epidemiological models may only serve as a start point for the investigators quest to provide robust recommendations in order to prevent recurrence, make the system safer and learn lessons across the whole of their industry and beyond.

This paper explores healthcare as a socio-technical environment in which the approach for analysing serious incidents and accidents is constantly evolving (in the UK this is currently on a month by month basis). The Healthcare Safety Investigation Branch in England is working to understand the socio-technical complexity of healthcare and they are taking a forward-thinking approach to the accident analysis of serious incidents and accidents in that domain. They are leading the world in the application of not for blame, independent safety investigation in this field. It is this approach and work by investigators in the UK which forms the evidence for this pilot study "Investigating Human Performance in Modern High Reliability Sector Organisations". A combination of many approaches is employed in healthcare in order to understand what, how and why serious incidents have occurred. Simple linear methods are used to determine what happened, more complex linear and systemic thinking helps to establish how and why, and the application of specific Human Performance Investigation methods, alongside clinical/technical approaches, are actively followed. Second and third victim considerations centre around staff, family members or other witnesses who may suffer or perceive to suffer trauma from the event under consideration. Early anecdotal evidence from investigations already concluded in the past 24 months in healthcare appear to support the move away from person centered investigations and a concentration on the proximal event and proximal actors. It is worthy of note that the systemic models at present across safety investigation tend to be restricted to theory and concept with regard to application, whereas the epidemiological models and approaches are actively being applied across industry including healthcare (HFACS, ARM, Maternity Investigation Matrix (MIM).

This research aims to take the concepts and theories around epidemiological and systemic models and create an applied approach, which follows traditional thinking only in the initial deconstruction of the event, but then goes further to consider:

– Context
– Narrative
– Positive action (not only negative causal path, but positive performance influence also)

This pilot study forms the basis of a much larger project which will continue over the next 24 months, and it will aim to provide a framework of key competencies, experience and knowledge for the healthcare safety investigator.

3 Research Question

- Is the Socio-Technical complexity of the healthcare environment adequately deconstructed for investigative purposes by the current accident analysis models in use across other High Reliability Organisations (HRO).
- Which skill sets (technical or non-technical) are most valuable to the investigator, conducting Human Performance investigations in healthcare.
- Are well-developed social skills or a well-developed social approach to investigation required for understanding patient safety occurrences and events in healthcare.

4 Method

4.1 Participants

This pilot study serves as the precursor to a much larger project planned for mapping the healthcare investigator competencies. The pilot has taken advantage of the recent requirement in the UK to qualify a large number of healthcare investigators (100+) over a relatively short period of time (18 months), and ensure these investigators are taking the same approach to "not for blame" independent and transparent investigation as employed by other State level investigators in the United Kingdom namely the Air, Rail and Marine Accidents Investigation Branches known as the AAIB, RAIB and MAIB respectively.

The aim of the pilot study was to capture what newly recruited investigators in the healthcare domain deem to be the most important personal qualities for them to demonstrate whilst conducting investigations. The perception being that their role will be centered around conducting a human performance investigation in the healthcare environment.

Investigators in this role understand their place within the wider Healthcare safety Investigation Branch, whereby clinical, technical Subject Matter Advisors (SMAs) are on hand to provide guidance with regard to specific clinical or technical issues. They clearly understood that they would however need to identify and understand technical and clinical factors present in their investigation and be able to recognise where these elements may sit within the context and narrative of the investigation.

The aim will be to revisit this cohort as they gain experience over the coming years in order to see how the theoretical competencies match the applied competencies over time.

More than 100 personnel have been selected for employment by the HSIB with varying levels of medical/clinical expertise, including some with no medical or clinical expertise at all. A key feature of their selection however has been with regard to their demonstrated (at interview) behaviours and attitudes which the management team perceive to be a good fit with the organization's currently perceived requirement of the healthcare investigation environment.

The participants (50) for the pilot study is almost 50% of the current population of specialist healthcare safety investigators. This is a high sample size particularly regarding the specialist nature of the investigator role being studied. All participants have undergone a rigorous interview process, they have completed a week of induction into the new Healthcare Safety Investigation Branch and are part way through their safety investigation training when the researcher has collected the data for this pilot study. Participants have at this stage a clear understanding of the aims and approaches of the organisation they have joined, the criteria by which an event requiring their attention as investigators will be triggered, the purpose of a safety investigation and some of the methods, tools and techniques available to the safety investigator.

Design and Procedure. One design has been used for the pilot study (initial generation of qualities of an investigator), though it is envisaged that two designs (generation of competencies and generation of a Hierarchal Task or Cognitive Task Analysis) will be required for the future (main studies).

Participants, having been selected for the role (as described above) were asked to first generate then rank the qualities of an investigator that they believe were most important for the type of investigation they understood they would be tasked with as soon as they had completed their training. Participants were given a short generic brief which introduced the concept of the qualities of a safety investigator. The socio-technical complexities across healthcare were discussed – their own generated understanding of this produced specific areas within health ranging from easier to describe, non-complex areas such as General Practice (GP) through to more complex difficult to describe departments like Emergency Departments (ED). A short exercise took place whereby they were asked to map these complexities across healthcare and then across their specific domain – maternity. This exercise was conducted in order to ensure each investigator was considering the full range of their investigator task domain, before addressing the research task. Participants were then split into groups of 4–5 individuals, and were allocated 20 min to discuss, generate, rank and agree upon up to 8 qualities they determine to be essential for their new role in healthcare. The participants were completely free at this stage to choose the descriptors they agreed reflected the best qualities required. They were not given a pre-determined list to rank as it is the researchers plan to use their list for future detailed studies involving more experienced (potentially the same investigators after they have concluded 10 or more investigations). Once complete, the investigators were asked to produce their ranking and discuss briefly the rationale for their list. All descriptors were collated and analysed across the groups for the prevalence of perceived importance.

5 Results

Figures 1 and 2 below shows an example of the complexity mapping exercise conducted by the participant groups. The groups were free to alter the language used to describe the complexity and they chose to move away from the Hollnagel descriptors of manageability (which they replaced with predictability) and tractability or coupling (which they replaced with interdependence).

The participants then generated their own list of descriptors for investigator qualities during this task. These were deemed essential to investigate human performance in the socio-technical areas identified above. These descriptors are:

- Communicator/Listener
- Team Player
- Empathy
- Integrity
- Resilient
- Approachable
- Compassion
- Credible
- Emotional Intelligence (EI)
- Curious
- Non-Judgemental
- Trustworthy
- Unbiased
- Self-aware
- Observant
- Kind

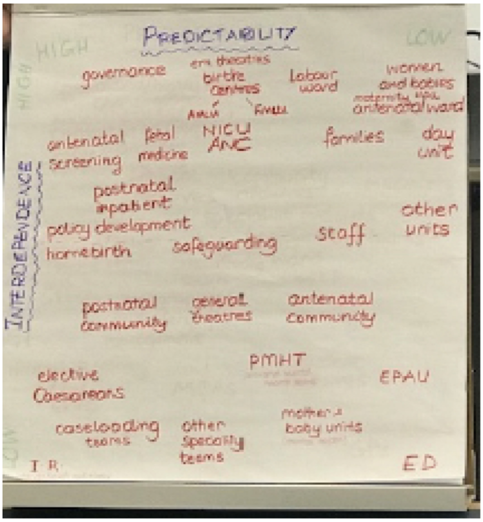

Fig. 1. Perceived socio-technical complexity across maternity

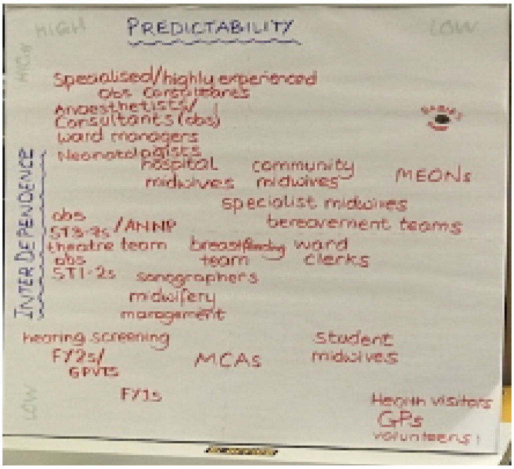

Fig. 2. Perceived socio-technical complexity across maternity

Tables 1 and 2 below show how the groups generated and then ranked these descriptors as small groups.

Table 1. Qualities ranked by cohort 1

Group 1	Group 2	Group 3	Group 4	Group 5
Good listener/communicator	Communicator	Integrity and honesty	Emotional intelligence	Good communicator
Kind/compassionate	Self-aware	Resilience	Empathy	Non-judgemental
Non-judgemental/objective	Trustworthy credible	Communicator	Communicator	Compassion ate
Approachable	Kind/emotional intelligence	Non-judgement al	Non judgemental	Kind
Dispassionate/self aware	Open and non judgemental	Curiosity	Approachable	Resilient
Inquisitive	Objective observer	Team-working	Kind	Independent
Resilient	Enquiring and analytical	Self awareness	Compassion ate	Open and honest
Independent	Resilient	Empathy	Trustworthy	Trustworthy
Open and honest				

Table 2. Qualities ranked by cohort 2

Group 1	Group 2	Group 3	Group 4	Group 5
Team player	Empathy	Team player	Emotional intelligence assertiveness	Communicator
Open minded	Patience	Impartial	Knowledge and experience	Open minded
Integrity	Communicator	Objective	Integrity	Compassionate
Non bias	Curiosity	Obsessive	Communicator	Emotional intelligence
Curiosity	Objectivity	Open minded	Flexibility	Kind
Humility	Integrity	Unbiased	Observant	Trustworthy
Thoroughness	Open minded	Patience	Leadership	Curious
Sense of judgement	Knowledge and skills	Good listener	Team player	Resilient
Compassion	Resourcefulness	Structured approach	Approachable	Credible

Once each cohort had completed the task, the combined ranking was analysed to check for prevalence of qualities identified. Figure 3 below captures this ranking.

Fig. 3. Maps the qualities ranked by the participants

6 Analysis and Discussion

When considering the results from this pilot study, it is of particular interest to note the lack of identified qualities which might be categorised as either technical skills or those qualities perceived to be of a clinical nature. These initial findings are similar in many respects to the results found in the recent study of investigator competencies, by Nixon and Braithwaite (2018) "What do aircraft accident investigators do and what makes them good at it? Developing a competency framework for investigators using grounded theory". However it is of note that these healthcare professionals did not consider or report on organisational logistics, leadership or the practicality aspects of investigation when deciding upon the descriptors they deemed the most important qualities. It is, of course, possible that once they have had more exposure to investigation these rankings may change and further studies with this cohort will allow studies of intra-rater reliability over extended temporal periods to be undertaken.

Each cohort clearly demonstrated their comprehension of the socio-technical complexity across the domain they would be working in and there was clear understanding and comprehension of the impact the technical environment had on the frontline worker in healthcare on a daily basis. The researcher discussed in length after each exercise how the complexity of the environment impacted "work as done" by those performing tasks in healthcare. It was made clear that the delegates, whilst conducting the mapping exercise were doing so showing due consideration to the human in the loop, the technology behind their activity and their place as agents alongside these technical artefacts.

When discussing current approaches the methods and concepts of safety investigation analysis, spanning simple linear, complex linear and complex non-linear systemic methods, each cohort was satisfied that they understood where they might apply the different approaches to different areas of healthcare. Where low interdependence but high manageability or predictability was identified, they thought this to be quite simple and easy to describe, therefore more simple linear methods (RCA, 5 Whys) could be used. As Interdependence became higher and predictability remained high, then epidemiological approaches were well suited (HFACS, ARM, MIM). Where interdependence was high, but predictability was low, they saw this to be the most complex and difficult to describe areas which would require a much more systemic approach in order to analyse the complex socio-technical environment (ACCIMAP, STAMP). The delegates then quantified the quality descriptors as being vital to take these current methods even further in order to properly uncover human performance narrative and context.

It was apparent from discussion between the researcher and the delegates following each stage of the study detailed above that the technical/clinical environment in which investigations would take place was well understood. The delegates were content that they either possessed the expertise required to understand this element of the investigation, or they could call upon that expertise from within their local or wider team if required. It is of note that the qualities associated with this technical/clinical expertise did not feature in the qualities deemed to be most important in their new role as safety investigators. Though these skills are taught and trained they were not ranked at all, instead the skills sometimes referred to as soft skills or non-technical, non-taught such as, for example; Emotional Intelligence and Empathy were deemed more important.

From a human performance investigation perspective the results of this early pilot study opens up the prospect of further detailed research as to the perceived importance of these non-technical skills. In a not for blame safety investigation where the focus is on why and how an event occurred "what or who" are only important in order to complete the narrative to understand the proximal event. An ability to de-construct the event in order to understand the component parts may still be essential, and there are already adequate tools available for the investigator to do this. However, this deconstruction is no longer important as a means by which only the negative or problem areas on the direct causal pathway are mapped, instead the positive interactions need to be identified and captured also.

In order to capture the positive and negative interactions and map their significance, the investigator needs to engage with front line workers, family members, management, regulators, manufacturers and policy makers across healthcare. They need these agents to be open and honest with them in the understanding that the investigation is not for blame and that they seek only to make the system safer, prevent recurrence of harmful events and learn lessons. It might be said that this is the same across other high reliability domains (Aviation, ATC, Power generation), however the healthcare domain from this early research with investigators does appear to have a broader range of socio-technical complexity for the investigator to work with – with the human in the loop balancing the resources which appear far less constant and predictable than that experienced in other high reliability domains. The complexity varies from medical Trust to medical Trust, department to department, ward to ward, and the investigator needs to employ a range of skills which will enable them to map this environment and put any event into the context in which it occurred.

The skills deemed important by the delegates in this study (detailed below) are all non-technical (some of which it might be argued cannot be taught) yet are crucial to deconstructing an event or outcome in healthcare in order to fully understand the human contribution, add context and build a narrative of the event.

- Communicator/Listener
- Team Player
- Empathy
- Integrity
- Resilient
- Approachable
- Compassion
- Credible
- Emotional Intelligence (EI)
- Curious
- Non-Judgemental
- Trustworthy
- Unbiased
- Self-aware
- Observant
- Kind

Taking just the top 4 identified qualities:

Communication/Listening. From discussion following the exercise - This skill or quality was deemed to be key to the success of the healthcare safety investigation. Investigative interviewing was identified as a key method of gathering information and data for analysis and the delegates perceived that this is an area where their own personal abilities and qualities around communication and listening would be crucial to their task.

Compassion. From discussion following the exercise - The delegates were very conscious that staff and family members involved in any event were also second or third victims affected by the event under investigation, there was a general opinion among the delegates that this fact has been often overlooked in healthcare investigation historically. The investigation should learn from these second and third victims and put measures in place to protect or prevent future or further harm or sign-post for help if required. This also applied to other team member involved it the investigation.

Non-judgemental. From discussion following the exercise - The delegates believed from experience that investigations in their domain were historically seen as punitive and disciplinary in nature (though often the stated aim of the investigation was that of safety) and that, this was not in keeping with the type of investigation they sought to conduct. They determined that by taking a non-judgmental, not for blame approach to the investigation, they would eventually win the trust of the organisation – resulting in a more just culture across healthcare. Delegates were clear in their determination that it is the investigation that is not-for-blame but it is crucial that the culture remains just whereby accountability is understood, but a willingness to speak up when genuine “human error” or human (socio-technical) interaction conflicts are identified is maintained. This becomes the start point in identifying systemic issues where previously it would be the end point of a person-centered investigation.

Team-Player. From discussion following the exercise - The delegates were clear that they would need to rely on the skills across the team in order to best conduct their investigation, complete their analysis and provide credible, workable reports and recommendations. Not all of the delegates were from a clinical, technical background and though these skills were highly valued by the cohort as a whole, it was the dispersion of these skills across the teams that was determined to be of most value. Healthcare and the environment where those working in healthcare reside within the UK system has become increasingly socio-technically complex across all domains, departments and specialist areas. Some areas and disciplines are far more complex and some far less complex than others, but they all rely on the human in the loop (system) to balance resources, safety, performance and output. Millions of interactions, interventions and procedures are conducted each day across the whole system, and the adaptability of the human agent in this system is often considered to provide the underlying flexibility, adaptability, Quality Assurance (QA) and oversight to manage many conflicting priorities and deal with challenges and conflicts as they arise. On rare occasion this “work as done” or normal functioning of the dynamic system may result in a harmful outcome, on other occasions there may be moments of brilliance that save the day – but on the whole, the day to day reality is some positive and some negative socio-technical interactions provide for the normal day to day functioning of the system whereby the output standard meets and sometimes even exceeds that expected.

Of note at this pilot stage of the study is the perception of the delegates that as the environment becomes more socio-technically complex, it is the human “softer skills” that are required to fully understand the human interaction within this complexity. Technical know-how and a clear understanding of policies, processes, procedures and systems needs to be available to the team of investigators, but the personal and cultural context and narrative needs to be equally accessible. These latter elements can only be uncovered in the investigation by dealing at a personal level with those human agents embedded within the system. Deconstructing events using traditional methods (linear, epidemiological and systemic) are all helpful tools and approaches for the investigator, which should be maintained, as they will help represent the scenario and will give structure to the analysis. This pilot study demonstrates however that in healthcare it is not necessarily sufficient to only isolate cause and effect linkages, causal pathways or only the negative consequences and outcomes – instead all of the positive human, technical, system and environmental elements need to be captured also. This needs to be done at a local level on a case by case basis, it is not adequately captured by reporting systems. It is skillful human-centered, (taking the human perspective and narrative of the human), not person centered (whereby the human at the sharp end is deemed responsible for the outcome) human performance investigations which are required to completely understand the human contribution in the healthcare system.

The qualities identified by the delegates are all deemed necessary to allow the investigator to engage at a personal level with those involved in events deemed to meet the criteria for conducting a professional safety investigation. The delegates were clear that these personal qualities were most important but could not be isolated completely from either personal technical, clinical or process knowledge and experience – or at the very least the availability of these technical, clinical skill sets at a local team level. It is interesting at this pilot stage to consider whether all professional investigators working in healthcare need to demonstrate these personal "soft or non-technical" skills identified by these cohorts, or is it sufficient to have adequate numbers of team members able to so dispersed across the teams. Discussion following the research alluded to the concerns that this personal interaction with first, second and even third victims on a regular basis, might bring with it some emotional risks for the delegates and although emotional intelligence and resilience were clearly identified as key qualities for the investigator, it may be unkind to expose only a few team members to this potential trauma or risk. This interaction is required though to understand the full context and build the narrative, to allow for credible, measurable safety recommendations to be generated.

7 Conclusion and Recommendation

The purpose of this pilot study was to:

- Begin to map the complexity of the socio-technical environment in healthcare.
- List the qualities of an investigator deemed essential for working in this environment.
- Lay the groundwork for future studies once the current investigation branch (in its infancy at present) becomes established and more mature.

The initial findings are extremely interesting in that they appear to indicate that as the environment is becoming increasingly socio-technically complex, it is the softer, non-technical (human-centered) skills that are required to understand narrative and context when unexpected outcomes occur. This may be particular to healthcare, due to the perceived caring function of the system as a whole, or it may be an indication that in order to determine how and why workers take particular courses of action on a minute by minute, or second by second basis we have to build rapport and trust rather than display objective critical thinking. This objective critical thinking will be required at a team level when applying investigative judgement and expertise, but it will only come after the data and evidence has been gathered, which in a human performance investigation setting means interacting with people in a manner which most accurately reflects the potential trauma felt by those people. The next stage for this study will be to re-visit these cohorts once they have significant experience conducting investigations. At this time a comparison will be made against the pilot study results to determine how robust these initial findings are and to begin to map the competency framework for future investigators.

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