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More holes than cheese. What prevents the delivery of effective, high quality and safe health care in England?

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ABSTRACT

What prevents the delivery of effective, high quality and safe health care in the National Health Service (NHS) in England? This paper presents 760 challenges which 330 NHS staff reported as preventing the delivery of effective, high quality and safe care. Some problems have been known for over 25 years (staff shortages, finance and patient complexity) but other challenges raise questions about the commitment of the NHS to patient and staff safety. For example, Organisational Culture leading to 'stifling bureaucracy', 'odds stacked against smooth […] working' and Workload resulting in 'firefighting daily' and 'perpetual crisis mode'. The role of Human Factors/Ergonomics professional input (engagement with safety scientists) is discussed in the context of success stories and examples of Human Factors Integration from other safety critical industries (Defence, Nuclear and Rail).

Practitioner Summary: 760 challenges to the quality, effectiveness and safety of health care were identified at Human Factors/Ergonomics taster workshops in England. These are used to challenge health care providers to think about a Human Factors Integration (HFI systems) approach for safety, well-being and performance for all people involved in providing and receiving health care.

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Introduction

There have been many papers written on safety in the health care industry since 2000 (Department of Health 2000; Kohn, Corrigan, and Donaldson 2000) but despite pockets of good practice (Xie and Carayon 2015) there seems to have been relatively little progress in embedding safer practice, technology and changing culture (Bagian 2012; Shekelle et al. 2013; Dixon-Woods et al. 2014). Wears (2015) reflected on this (and other topics) suggesting that the lack of progress is possibly due to 'medicalization' of the area (selective engagement), where 'a certain school of thought among health professionals – managed to take it over, displacing other forms of scientific and professional activity, and turning it from a reformist movement to a conventional, business-as-usual activity, ironically with the best of intentions'. This includes a lack of engagement with safety scientists (including Human Factors/Ergonomics (HFE) specialists) in contrast to the response by other safety critical industries when tackling entrenched safety challenges (Ministry of Defence 2008; Office for Nuclear Regulation 2014; Office of Rail and Road 2008). The failure to utilise professional expertise has been commented on by Peerally et al. (2016) where root cause analyses for serious untoward events (including death) will be 'typically conducted by local teams, not the expert accident investigators who are proficient in systems thinking and human factors, cognitive interviewing, staff engagement and data analysis that are characteristic of other high-risk industries'.

In the UK, there have been initiatives to introduce HFE since 1990 after a change in legislation in 1986 when Crown Immunity from prosecution under the Health and Safety Act 1974 (Seccombe 1995) was removed. This meant that the UK National Health Service (NHS) had to comply with safety legislation as hospitals and other care locations were considered to be places of work. HFE input was used in 1980s–2000s for building design (Hilliar 1981), occupational health (Straker 1990) and systems approaches to embed HFE as part of the organisational culture (Hignett 2001). The interest in safety moved from staff to patients after the Bristol heart scandal (Department of Health

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Figure 1. Word cloud of challenges preventing the delivery of effective, high quality and safe care.

2002) with seminal publications on the level of iatrogenic harm (Department of Health 2000; Kohn, Corrigan, and Donaldson 2000) reporting that at least 10% of patient admissions may result in some form of harm. A National Patient Safety Agency (NPSA) was established in 2005 with some excellent Human Factors projects (Norris 2009) but was closed in 2012 with all the HFE professionals leaving NHS England.

In 2013, a Concordat was signed by 16 health care agencies in England (including professional regulators, inspection agencies and education providers) stating that 'a wider understanding of Human Factors principles and practices will contribute significantly to improving the quality (effectiveness, experience and safety) of care for patients' (National Quality Board 2013). One of the initiatives to implement the Concordat was a series of HFE taster workshops (2 h) in collaboration with the UK professional body for HFE (Chartered Institute of Ergonomics & Human Factors [CIEHF]) to a wide range of NHS staff. The workshops aimed to raise awareness of HFE as a scientific discipline and profession amongst health care professionals, leaders and decision-makers.

This paper will (1) present and discuss the challenges which the NHS staff felt prevented the delivery of effective, high quality and safe care and (2) discuss how a HFE approach could be applied to some of these challenges.

Method

A series of HFE awareness raising (taster) workshops were delivered to over 500 health care staff through Health Education England (HEE)[1] regional groups (https://www.hee.nhs.uk/hee-your-area) between June and December 2015. The 2-h workshop (accredited as a short course by CIEHF) provided an introduction to HFE principles and applications based on the International Ergonomics Association Core Competencies (IEA 2001). The learning outcomes were to demonstrate an introductory knowledge of HFE principles and practices; discuss HFE problems in terms of understanding capabilities as design challenges for all the humans (both staff and patients); and discuss interventions in current systems (culture and processes) through re-design rather than adding work. The details of the workshop have been reported elsewhere (Hignett 2015; Health Education England 2016).

A pre-workshop online survey was developed and piloted with 37 staff in two preliminary workshops. Changes were made to simplify the content (e.g. condensing clinical specialities into higher level categories) and add an option to decline to record any safety challenges. The survey collected data about professional roles

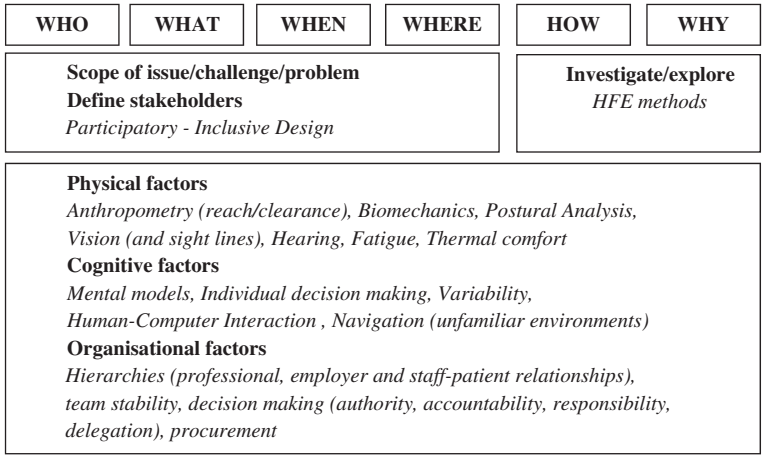

Figure 2. HFE framework used in Taster workshops (Hignett 2015).

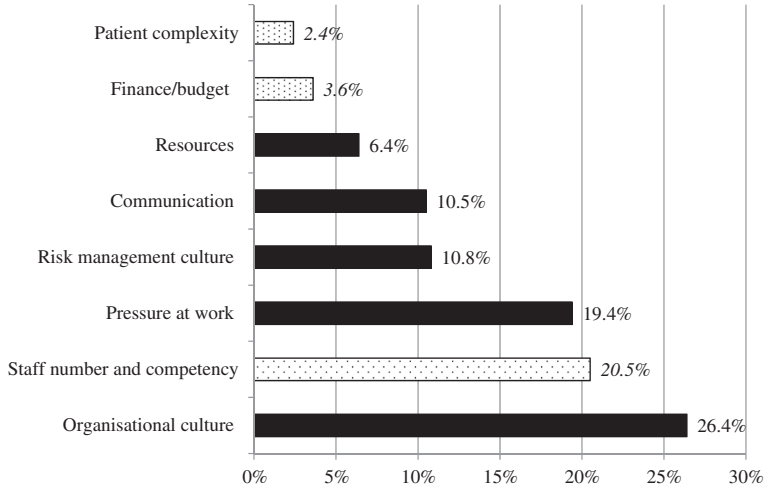

Figure 3. Challenges preventing the delivery of effective, high quality and safe care.

with options for direct health care provider, manager (and combination of direct provider/manager), support to care provider (e.g. education, audit) and operational services (e.g. information technology). The clinical service sector was recorded as acute, rehabilitation/community hospital, GP practice, mental health organisation, hospice care, local authority, community health organisation, community pharmacy or social care organisation.

The survey asked the workshop delegates to complete free text fields to identify the top challenges which they felt prevented the delivery of effective, high quality and safe care. Responses were received from 330 health care staff identifying 760 challenges. The free text narrative data were imported into NVivo 10 (http://www.qsrinternational.com/what-is-nvivo) and a two stage analysis was carried out by firstly organising, reducing and describing the data through primary coding using the Query (Word Frequency) function in NVivo to give a literal Tag Cloud output (Figure 1). The second stage of interpretive analysis used an iterative process (Hignett and McDermott 2015) with the Tag Cloud categories for 'top-down' coding and additional emergent categories from 'bottom-up' coding. The generation of codes continued until theoretical saturation (no new instances) was achieved and then all data were reviewed to check for exhaustive and inclusive coding.

The preliminary Tag Cloud codes used for group work discussions within an HFE framework (Figure 2; Hignett 2015) were:

- Resources: including finance, staffing (including numbers, competencies, workload, stress/burn out, and training) and technology (missing and defective equipment).
- Systems: including communication, Information and Communication Technologies (ICT), reporting tools, patient care pathway, policies and procedures, interconnectivity between patients, care providers, technology systems and lack of standardisation.
- Culture: including hierarchies (clinicians, managers, non-registered staff), instability (of NHS at a national level, individual organisations and local teams), silo-working (professions, specialities and sectors), increasing demand and service expectations (from patients and NHS targets), blame culture and a lack of clear vision leading to sustainability.

No additional data were recorded from discussions at the workshops so a secondary more detailed analysis was carried out on the narrative data from the survey. This ensured that all data were included (accountability) to give an audit trail for internal validity. The resultant higher level codes were subsequently discussed and presented to health care audiences to address issues of external validity.

Results

The workshop delegates included direct health care providers ($n = 135$, of whom 7 were also managers), managers ($n = 76$), support staff ($n = 35$) and other staff (operational services, clinical researchers). Most were from the acute sector (63%), with some staff from community services (13%), local authority (7%) and mental health (6%) settings. To gain an understanding of clinical activities, delegates were asked if they were registered with a professional regulator. Doctors (General Medical Council) accounted for 35% of delegates, nurses (Nursing and Midwifery Council) for 33%, allied health professionals (Health Care Professionals Council) for 16%, pharmacists (General Pharmaceutical Council) for 8%, dentists (General Dental Council) for 3% and other professions for 4%. Although the workshops were presented to over 500 staff, workshop

attendance varied across locations (with some failing to keep attendance registers).

The secondary thematic analysis recoded the challenges into eight higher level themes (Figure 3): organisational culture (26.4%), staff numbers and competency (20.5%), pressure at work (19.4%), risk management culture (10.8%), communication (10.5%), resources (6.4%), finance/budget (3.6%) and patient complexity (2.4%).

At this stage, a pragmatic decision was taken to recognise that HFE may be beneficial in some, rather than all, themes. For example, the themes of patient complexity (2.4%), staff numbers and competencies (20.5%) and finance (3.6%) have been known for over 25 years (Audit Commission 1991) relating to the ageing and increasingly frail population, shortage of nurses and other staff, and political changes. These themes are widely discussed elsewhere (for example, Iacobucci 2016) and will not be further discussed in this paper.

Some of the data were coded in more than one theme, but where possible the data were coded exclusively in individual codes, for example, some ICT issues were recorded as administration bureaucracy (in the Organisational Culture theme) to represent the policy whereas challenges associated with individual communication interfaces between sectors and individuals were coded to the Communications theme. Examples of the themes and illustrative quotes are as follows:

Organisational culture (26.4%)

- Leadership: including accountability, reporting structures, lack of management support/vision 'executive level engagement of initiatives' (D155), lack of support for innovation and change 'inability of staff to make small incremental changes to the own and local practice' (D330); challenging personalities within teams; different values and drivers 'organisational moving obstacles – too many moving parts meaning that the odds seem to be stacked against smooth theatre working rather than in their favour' (D20) and individual agendas 'people looking at only their interests and covering their own back, therefore leading to over-defensive medicine and management of personnel in the NHS' (D222).
- Models of working (system culture): including complex and/or historical systems patient pathways 'complexity of policy/procedure' (D213); lack of integration (silo working) and standardisation including discharge; organisational policies and processes 'clinical guidelines that don't make accessing information easy' (D25); and roles/responsibilities 'difficult in-house structures which means that reporting lines are not transparent' (D89).
- Administration bureaucracy: including duplication (task and paperwork) 'stifling and increasing bureaucracy within the NHS taking care away from patients' (D65); ICT 'non-seamless, user unfriendly IT' (D131); and purchasing processes.

Pressure at work (19.4%)

- Reactionary system operation: including department full/blocked; increasing number of patients 'firefighting daily' (D27); and discharging patients too early 'perpetual crisis mode, difficulty making time for thinking and planning, implementation, follow through' (D293).
- Staff: physical and cognitive (stress) well-being; morale, commitment and enthusiasm 'stress and concurrent sickness rates due to pressures to meet targets, patients with higher acuity and care needs' (D84).
- Time pressure: 'time poor over stretched staff becoming disengaged in their roles' (D257), 'lack of time to obtain patient and carer views in other than perfunctory ways' (D327).
- Coping: including workforce resilience; competing priorities; following procedures; lack of teamwork; and lack of team continuity

> lack of continuity in the team I work with Nursing team on my ward is not consistent. We do not have single "sister in charge" and there are frequent changes from day to day which impedes development of team relationships which improve outcome for patients on the ward. Also ward rounds are led by 4 different people across 5 days in the week – which feels disjointed. (D28)

Risk management culture (10.8%)

- Focus on safety issues: including blame; human error; safety; HFE; Quality Improvement (QI); risk management; and clinical governance; 'recognition of safety issues' (D72), 'organisations focusing on data rather than the 'what have we done about it?' (D84) and 'hierarchical/pervading blame culture' (D91).
- External pressures (e.g. regulations and inspections): 'too many other priorities/expectations e.g. from Regulators who also don't appear to be on board with how to truly improve quality' (D190).

Communication (10.5%)

- Communication system between sectors: 'fragmentation between services' (D296), multi-disciplinary

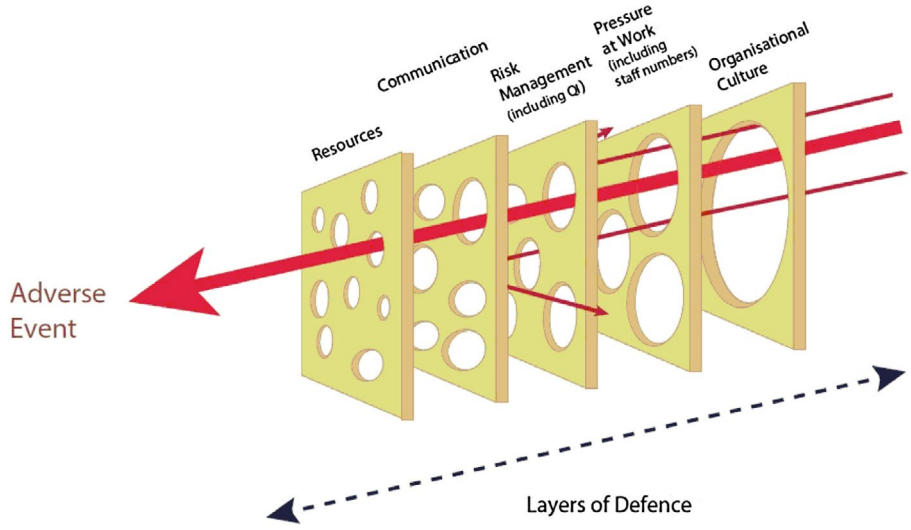

Figure 4. More holes than [Swiss] Cheese to represent the lack of barriers for unsafe acts (inspired by Reason 2000).

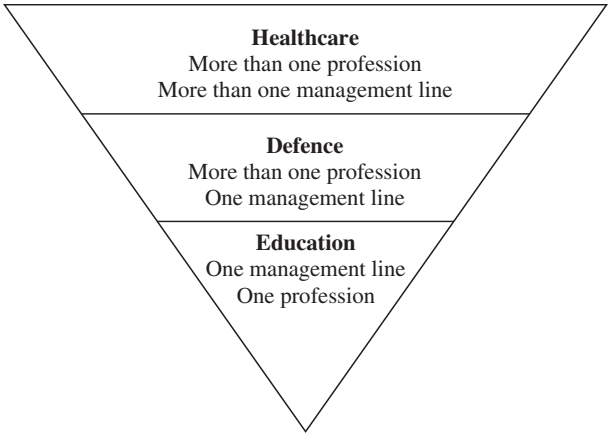

Figure 5. Management hierarchies in Service Industries (modified from Hignett 2003).

teams/staff including handover and outliers, and patients' expectations (compliments and complaints) 'systems design i.e. interconnectivity between people, care providers, technologies' (D129).

- Communication lack and barriers 'communication physical barriers – bleeping the correct person, being bleeped, finding a phone to answer back on' (D20).
- Communication: distractions/interruptions 'lack of consideration to environmental factors that impact on humans and processes e.g. distractions/interruptions' (D323).

Resources (6.4%)

- Including equipment (missing, available, defective etc.); limited space and environmental problems 'materials inaccessible or difficult to locate in a timely-fashion' (D69).

Discussion

Before discussing these themes and the role of HFE, it is acknowledged that the data have limitations due to the self-selection by delegates for both workshop attendance and completion of the pre-workshop survey.

The five themes have been represented in a modified [Swiss] Cheese model (Figure 4) to represent the greatest challenges to the delivery of effective, high quality and safe care. The lack of barriers for each theme is represented by the size and number of holes in each cheese slice.

In this paper, the Organisational Culture theme is represented as 'more hole than cheese' as it continues to be an 'ultimate challenge' (Leape 2004). Organisational culture as a theoretical concept has been discussed and defined by many academic disciplines (Helmreich and Merritt 1998). This has led to opportunities for health care safety initiatives to be selective both about the term and the concept depending on the interests and focus of the researchers. Over the last 30 years, there have been many appeals for cultural change in the NHS with some success 'in changing some of the surface manifestations of medical culture … [but] less successful in penetrating the deeply entrenched values and beliefs (and power bases) that underpin clinical practice' (Davies, Nutley, and Mannion 2000) and it is likely this will continue with new initiatives at least every 5–10 years to restructure at national and local levels.

One of the first issues often raised about health care organisational culture is the complexity of the dynamic system(s) within care organisations, across care sectors and between professional domains (Carayon and Wood 2010).

There are three main aspects to Human Factors that can impact on people's health and safety-related behaviour.

- *Job: Tasks, workload, environment, displays and controls, procedures.*
- *Individual: Competence, skills, personality, attitudes, risk perception.*
- *Organisation: Culture, leadership, resources, work patterns, communications*

Human Factors cuts across the boundaries between many traditional railway industry disciplines and yet adequate management of Human Factors is often overlooked. Human Factors are not a series of independent issues to be conveniently addressed in isolation, or on a piece-meal basis. Nor can Human Factors be effectively incorporated just before the end of a project or design process. Instead, Human Factors considerations should be integrated throughout the lifecycle of systems development, functions of the owner organisation and the different roles of individuals in project teams.

Figure 6. Human Factors in the Rail Industry (Office of Road and Rail; http://orr.gov.uk/publications/guidance/health-and-safety/human-factors-guidance).

The organisational complexity of the NHS was previously represented and compared with other sectors by Hignett (Figure 5: 2003) to show the NHS hierarchy with multiple professional and management lines. This was contrasted with other service (public) domains with Defence as a multi-professional organisation with one managerial line and Education as a single (combined) management and professional structure.

We suggest that one of the first contributions HFE experts can deliver is understanding and experience of safety integration within complex systems. HFE input has been successfully delivered in the UK Defence sector across domains for the army, navy and air force and across many professional groups. There are both examples of HFE Standards (Ministry of Defence 2008, 2015) and definitions for HFE Suitably Qualified and Experienced Person (SQEP; Ministry of Defence 2015). There are also examples from other complex safety critical industries, for example, Nuclear and Rail. In the Nuclear sector, the HFE SQEP roles have been delivered as 'both in-house and consultants to move the HFE programme forwards' (Office for Nuclear Regulation 2014). In health care, the concept of SQEP has been discussed by Williams and Bagian (2010) as part of the HFE in patient safety training program at the Veterans Health Administration National Center where they comment that 'clinicians understand that they put patients at risk when diagnosis and treatment of pathophysiology lie outside their expertise'.

The scope of HFE potential at the organisational level can be seen from the UK Rail industry the last 17 years where HFE has successfully been integrated across multiple organisations (Network Rail, Train Operating Companies, Railway Safety and Standards Board – http://www.rssb.co.uk/improving-industry-performance/human-factors). The UK rail regulatory bodies (Office of Road and Rail (ORR) and the Rail Accident Investigation Board) have SQEP HFE professionals employed to review and advise on risk and safety management. The HFE principles are embedded and used to 'inform any major change as well as evaluations of intended or actual system modifications with areas of activity embracing culture, competence, cognition, equipment, environment, functions and tasks as part of a systems approach' (Wilson 2014) with a clear structure for application (Figure 6).

The Pressure at Work slice also has large holes to reflect the lack of barriers for what was described as a reactionary system with full/blocked departments, time pressures, competing priorities and coping strategies including work force (rather than system) resilience. There are research studies linking excessive workload to increasing errors, for example, nurses working shifts longer than 12 h or for more than 40 h per week (Olds and Clarke 2010; Rogers et al. 2004) and interns working 'frequent shifts of 24 h or more' (Landrigan et al. 2004). In the aviation industry, workload as flight time limitation has been addressed since 1944, with harmonised minimum European criteria from 2008 and consideration for human performance throughout the 24-h period ('Window of Circadian Low'; European Cockpit Association 2007).

Health care practitioners frequently modify their work practices as part of individual and team coping strategies. This ability to adjust to uncertainties provides resilience within the system to sustain and balance the goals of safety and efficiency. However, such adjustments may also be cited as a contributory factor for an unsafe event (incident) especially where investigations focus on human behaviour (blame culture) rather than proactive risk management. We suggest that this has created a misunderstanding in the term resilience, where staff training (human resilience) in leadership, teamwork and communication is proposed

rather than system resilience; this results in [trained] staff continuing to work in pressured conditions. The term resilience, in the context of HFE, relates to resilience engineering (Hollnagel, Woods, and Wreathall 2011) and seeks to understand how a system can be engineered to anticipate and monitor variability in a system whilst recognising why this occurs, and how engineering (system) responses can preserve safety. Increasing the human resilience ignores the influence of the whole system and is likely to result in increased pressure on staff, as reported by the workshop delegates.

Risk Management slice has been used to cover a wide range of operational issues including quality improvement, financial risk (corporate governance) and clinical governance (Scally and Donaldson 1998). In the NHS, quality and safety were explicitly linked in the late 1990s following the Bristol heart scandal (1984–1995; Department of Health 2002). There have been multiple initiatives which have included clinical audit, clinical effectiveness, education and training, research and development, openness, risk management and information management. As mentioned earlier, the NHS tends to restructure every few years and these initiatives have been led by the Commission for Health Improvement (CHI, 1999–2004; Day and Klein 2004), Commission for Health Audit and Inspection (CHAI, 2004–2009), Care Quality Commission (2009-), the National Quality Board (2009-), NPSA (2001–2012), NHS Institute for Innovation and Improvement (2005–2013), NHS Improving Quality (2013–2016) and NHS Improvement (2016-). In 2016, the Care Quality Commission (Care Quality Commission 2016) reviewed the way that NHS acute hospitals investigated serious incidents and gave five recommendations. HFE professionals can directly respond to two of these by providing

> skilled analysis to move the focus of investigation from the acts or omissions of staff, to identifying the underlying causes of the incident' and 'human factors principles to develop solutions that reduce the risk of the same incidents happening again.

The challenges of Communication within complex systems are not new. Nembhard and Edmondson (2006) discussed an entrenched status culture in health care which contributed to the barriers for integrated working across sectors and professional boundaries, and possibly also to patient safety events (Institute of Medicine 2003). Information systems in health care do not currently benefit from standards which require the application of HFE or user centred design principles (BS EN ISO 13407 1999; BS EN ISO 9241-210 2010). The Health and Social Care Information System is the UK national provider for information, data and technical systems in health care. It is responsible for the setting up and managing of ICT systems in health care and sets the standards and guidelines for data collection and reporting of information. We suggest that the current approach is driven by technology providers offering like-for-like technical solutions for existing systems as a 'one size-fits-all' solution rather than working with HFE professionals to understand and redesign the ICT systems in contrast to the mandatory involvement of HFE for Defence procurement (http://www.scs-ltd.co.uk/wp-content/uploads/Case-study-DTT.pdf). This approach may create a stagnant ICT culture where health care staff are stifled by lack of engagement with their working priorities and operational needs despite optimism about benefits from ICT and opportunities for a more co-ordinated 'joined up' way of working (Waterson 2014). HFE has yet to be fully integrated nationally into either the development process or evaluation of health care technology systems which in some cases mimic unreliable or inefficient paper version and require staff to 'work around' the final product (Clarke, Belden, and Kim 2014).

Accessing Resources (equipment and consumables) is represented in Figure 4 as the slice with the fewest holes suggesting a fairly robust barrier; however, this may be due to the coping culture rather than a reflection of good practice in procurement and logistics. Cox, Chicksand, and Ireland (2005) commented on a health care procurement

Integration: who, what, when, where, how and why

- Who = Every one: patients, staff, visitors, contractors, NHS policymakers, board members, commissioners etc.
- What = Safety as performance (quality) and wellbeing issue
- When = All the time (including emergencies, CBRNe etc.)
- Where = All sectors and locations
- How = Embedded and SIMPLE by design of systems including workplace procedures, undergraduate and postgraduate training, national policy and procurement etc.
- Why = Human sympathetic (we all have limitations…)

Figure 7. Human Factors Integration principles for Healthcare: who, what, when, where, how and why.

dichotomy of 'clinical effectiveness versus cost effectiveness' in terms of the 'rights of clinicians to design and specify requirements individually without any real consideration of the commercial consequences of their actions'. This describes a tension which HFE is well placed to support through product evaluation and user trials (Hignett 1998, Hignett and Lang 2003). A Usability and HFE standard has been established since 2008 (ISO 62366) and makes explicit links to the associated risk management standard (ISO 14971, 2007) to ensure that manufacturers consider potential risks of system use and integration and also, where relevant, the life cycle of medical device software (IEC 62304, 2006). The integration of HFE into the building design process has been encouraged since the 1980s (Hillier, 1981) and most recently with an evidenced-based resource from the USA (Taylor and Hignett 2014) encouraging a systems approach to safety in building design (https://www.healthdesign.org/insights-solutions/safety-risk-assessment-toolkit-pdf-version).

Conclusion

So why is the NHS still lagging behind other public sector safety critical industries in the application of HFE principles and practices (SQEP)? The taster workshops identified the lack of barriers (more holes than cheese) in NHS systems. We propose that the way forward is to learn from other industries, in particular Defence, Nuclear and Rail. There needs to be a discussion about principles for Human Factors Integration in health care (Figure 7) to address the challenges of organisational culture, pressure at work (workload), risk management, communication and resources.

This presents a challenge in England where the primary response to patient safety has been to provide behaviourist training (Crew Resource Management; Catchpole 2013). An HFE approach does not incorporate training as its primary element although it is important that staff receive training in the systems of work and work equipment to (hopefully) be able to respond when things go wrong. For predictable challenges, an HFE system will be designed to respond and be resilient to all conditions, for example, in infection prevention and control 'design systems, the workplace, and devices that influence correct, compliant human behavior and make it easy and efficient to do the right thing at the right time' (Anderson et al. 2010).

The role of the patient is central to an HFE approach and our late colleague, Prof. John Wilson reflected on his experience as a patient by describing 'systems of systems' in health care as nested and overlapping (parent/sibling) systems;

> bed in a hospital is a system, the patient monitoring equipment is a sibling system, the two together plus the patient's room comprise another system, …; whereas the radiology or scanning equipment, the drugs dispensary, the beds, the ambulances are all systems, but together can be seen as a system of systems when looking at maintenance and replacement regimes. (Wilson 2014)

Although many of these challenges are not new, the survey information has provided an opportunity to present and discuss NHS staff concerns about the delivery of effective, high quality and safe care. The role of HFE professional input has been discussed with examples from other UK safety critical industries and we believe that Human Factors Integration is vital to enhance safety in health care. However, we suggest that no progress will be made unless the HFE input is delivered by qualified (SQEP) professionals in collaboration with health care staff so that the full potential of HFE in health care can be realised.

Note

1. HEE is a non-departmental Government Public Body that exists to support the delivery of excellent health care and health improvement to the patients and public of England by ensuring that the workforce of today and tomorrow has the right numbers, skills, values and behaviours, at the right time and in the right place.

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