Healthcare Ergonomics:  
Reaching out into all areas of Clinical Practice 
(or Touching and Analyzing the Elephant) 

Sue Hignett 

*Loughborough Design School, Loughborough University, Leicestershire, UK*

By reaching out into clinical practice, this paper will consider how Human Factors and Ergonomics has been, and can be, used to support patient care, experience and safety as well as caregiver wellbeing and performance in the provision of services for treatment, recovery and rehabilitation. It offers a personal perspective and narrative from over 30 years of experience in the healthcare industry as a clinician, ergonomist, researcher and patient.

**Practitioner Summary:** Maximizing the opportunities and benefits of integrating safety and performance initiatives (and metrics) for both patients and caregivers using Human Factors and Ergonomics.

**Keywords:** Patient Safety, Caregiver Wellbeing, Human Factors, Quality Improvement.

1 Introduction

The need for Human Factors and Ergonomics (HFE) in healthcare has been recognised since the inception of the profession and discipline but development and growth have been slow (Carayon, 2010; Norris, 2012; Gurses, Ozok and Pronovost, 2012). The reasons for this include system complexity, gender, and cultural taboos.

Firstly, the complexity of a dual human interface as a ‘people-centered and people-driven’ industry (Van Cott, 1994) contrasts with other more technology-centered industries with single human-machine interfaces.

Secondly, healthcare is a major employer of women with, for example, more than 75% female employees as part of the 1.3+ million work force in the UK National Health Service (Dargie, 1991). It is suggested that this issue is only recently being addressed with respect to the difference in jobs, working conditions, circumstances and societal roles resulting in different workplace risks for women (European Agency for Safety and Health at Work, 2014). The third reason reflects the cultural taboos involved in the interactions, where the work ‘often involves heavy physical, dirty, cognitively difficult and challenging emotional work where professional subcultures allow the handling of other peoples’ bodies. The body is touched continually by many pairs of hands, including private, highly connotative regions, orifices and cavities of the body that are ordinarily touched only in the most intimate personal relations and contexts. The body is persistently under observation. Many of the diagnostic and therapeutic actions conducted in the hospital involve taking substances from patients’ bodies – blood, urine, mucus etc. Under no institutional ‘roof’ other than the hospital is the human body handled and worked on in all these ways’ (Fox, 1989).

The first conference on healthcare (hospital) ergonomics was held in Paris in 1991 (Estryn-Behar, Gadbois and Pottier, 1995). This was followed by the foundation of the International Ergonomics Association (IEA) Technical Committee on Healthcare Ergonomics and Patient Safety (HETC9) by François Daniellou in 1997. Since 2005 there have been regular conferences on healthcare and patient safety ergonomics as well as sessions and papers at clinical (patient safety) conferences (Hignett et al, 2013a).

This paper will consider how HFE has been, and can be, used to support patient care, experience and safety as well as caregiver wellbeing and performance in the provision of services for treatment, recovery and rehabilitation. It will discuss the opportunities and benefits for integrating safety and performance initiatives (and metrics) for both patients and caregivers.
2 Touching the Elephant – the scope of HFE in healthcare

The analogy of blind humans touching an elephant and coming away with completely different descriptions is well known and has been captured in John Godfrey Saxe’s (1816-1887) poem of the Blind Men and the Elephant. The six humans approached the topic of interest with the intent to learn, observe and satisfy their minds. But, with limited perspectives (worm’s eye view) and data gathering tools formed ‘exceeding stiff and strong’ opinions which were disputed ‘loud and long’ with the result that each was partly correct, but all were wrong. Recently in healthcare it has been suggested that ‘Human Factors’ is different to ‘Ergonomics’, with new definitions proposed for ‘Clinical Human Factors’ and there have been discussions in clinical journals both proposing and refuting the need for a new definition (Catchpole, 2013; Hignett et al, 2015). This discussion, in my opinion, has been and may continue to be, divisive and limiting for both professional practice and education; the fundamental HFE principles are the same across all domains and industrial sectors and the internationally agreed definition for HFE should be used (IEA, 2000), with interpretation, explanation and case studies.

There are excellent examples of the successful use of HFE in healthcare in a variety of different domains, locations and environments (Hignett et al, 2013a). The first applications of HFE in healthcare were for caregiver (worker/staff) wellbeing and performance and this has developed and expanded over the last 15 years to include all the humans in the system, with an increasing focus on patient safety. The integration of HFE for caregivers and patients requires ‘working across boundaries’ (Carayon, 2006). This is a major challenge for HFE as the culture of healthcare has many boundaries within and between professions (e.g. anaesthesiology, surgery and nursing within an operating room) and organisations (e.g. primary and secondary care providers). There are conflicting hierarchical lines for administrative, professional (e.g. Royal Colleges) and clinical decision-making with respect to accountability, authority and power (Hignett, 2003); healthcare marches ‘to the tune of developing professional practices and expanding technology possibilities with individual professionals free to indulge in their own improvisations’ (White, 2000). So where do we start?

The first stage has seen the generation of many models, with Reason’s Swiss Cheese model (Reason et al, 2001) being one of the most popular by proposing a process and behavioural perspective of adverse event trajectories. Catchpole (2013) commented that ‘this behavioural safety approach, while entirely legitimate and increasingly well evidenced, is limited. Yet, it has dominated perceptions of what constitutes HF and shaped the application of HF principles in healthcare. Frequently espoused by well-meaning clinicians and aviators, rather than academically qualified HF professionals, it has led to misunderstandings about the range of approaches, knowledge, science and techniques that can be applied from the field of HF to address patient safety and quality of care problems.’ More recent models have considered how system components can influence human behaviour at the organisation, employee (caregiver) and patient (service user) levels (SEIPS, Carayon et al, 2006) with closer analyses of specific domains. These models have described patient roles in the system as mostly passive (things are done to them/us) rather than active, where they/we choose whether to follow instructions, participate in treatment or even attend appointments. The second stage is, therefore, to acknowledge and design for the dynamic complexity of these multiple human interfaces. This is seen with more recent models which include explicit roles for patients (SEIPS 2, Holden et al, 2013; DIAL-F, Hignett et al, 2013b).

3 Analyzing the Elephant – a Model for Integration

In the UK, there is a renewed focus in taking an HFE approach to tackle patient safety issues as part of the response to the catastrophic failings in the quality and safety of care at Mid Staffordshire NHS Foundation Trust (Flin et al, 2013). The National Quality Board Concordat ‘Human Factors in Healthcare’ brought together 16 agencies (including professional colleges, regulators, commissioners, patient groups, and government departments) to support the statement: ‘We, the undersigned, believe 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’ (NQB, 2013).

As a response to this Concordat, the Chartered Institute of Ergonomics & Human Factors (CIEHF) has run introductory ‘Taster’ workshops to introduce HFE across England. This is both a major opportunity and challenge. The messages are being delivered across professions, care sectors and for both clinical and non-
clinical caregiver to discuss how HFE can be embedded and integrated at all levels. This requires a typical HFE systems approach for top-down management and bottom-up implementation (Hignett, 2001).

The first challenge has been to gain an initial awareness and understanding of HFE as a separate discipline and profession to quality improvement (QI). Quality initiatives have been used in the UK healthcare system for over 30 years, with “sporadic efforts to implement quality circles and TQM [Total Quality Management]... in the 1980s and early 1990s” (Ferlie and Shortell, 2001). These early initiatives focused more on organisational performance and efficiency than safety. Quality and safety were not explicitly linked in healthcare until the late 1990s as “the language of error and harm had not entered healthcare discourse” (Vincent, 2010).

Both QI and HFE provide powerful philosophical and practical approaches to the improvement of healthcare. Both address complexity; HFE by understanding and structuring improvements / interventions based on human capabilities and limitations, and QI by supporting front-line caregivers with a theory and method of improvement to identify problems, and then iterating towards local solutions within that complexity. The drivers for QI are mostly linked to performance (commissioning or reimbursement), whereas the drivers for HFE are to improve both productivity and human wellbeing (including safety). In QI, the processes are mostly delivered by people but they are not the focus of the improvement (Hignett et al, 2015). Rather than introducing HFE as a completely new work stream and potentially adding to workload, the interface between HFE and QI has been explored with the hope that HFE can add to the existing extensive QI framework across healthcare and thus enhance existing initiatives. Hignett et al (2015) offered a four-step framework to:

1. Explore and define a problem by looking at the humans and the rest of the system (HFE and QI).
2. Re-design the tasks, interfaces and system (HFE).
3. Define the elements of the intervention and process measures (QI and HFE).
4. Implement the change using expertise in improvement methodology, facilitation and coaching skills, and recognition and reworking of barriers (QI and HFE).

The framework for HFE analysis that is being used (Figure 1) offers the possibility of building in QI for ‘Who’, ‘What’, ‘When’, and ‘Where’ steps, with the ‘How’ and ‘Why’ inputs explicitly delivered using HFE methods. The CIEHF 2015 taster workshops are:

- Introducing HFE principles as systems and design concepts.
- Discussing opportunities for integrated QI and HFE projects.
- Supporting in thinking about HFE solutions to improve wellbeing and performance for caregivers and patients.

<table>
<thead>
<tr>
<th>WHO</th>
<th>WHAT</th>
<th>WHEN</th>
<th>WHERE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope of issue/challenge/problem</strong></td>
<td><strong>Define stakeholders</strong></td>
<td><strong>Investigate/explore</strong></td>
<td><strong>HFE methods</strong></td>
</tr>
</tbody>
</table>

**Physical factors**
- Anthropometry, Biomechanics, Postural Analysis, Vision, Hearing, Thermal comfort

**Cognitive factors**
- Mental models, Individual decision making, Variability, Human-Computer Interaction

**Behavioural factors**
- Hierarchies, Team stability, Navigation (unfamiliar environments)

**Organisational factors**
- Hierarchies (professional, employer and staff-patient relationships)
- Decision making (authority, accountability, responsibility, delegation)
4 The future for HFE in Healthcare

In the UK, design has been seen as an important component in patient safety since the 2000s with projects on electronic infusion devices, medication labelling, computer interfaces and ambulances (NHS, 2015). This continues in 2015 with initiatives to embed HFE in healthcare across both product and systems led by Health Education England ‘...to ensure that the practices and principles of human factors are integrated into all training and education ....to develop the future healthcare workforce by ensuring it contains individuals with the right skills, attitudes, behaviours and training, to enable the delivery of excellent healthcare and drive improvements for the quality of care provided and the safety of our patients’ (Health Education England, 2015).

The HFE profession now may face a major challenge in capacity with, for example only 5 universities in the UK providing HFE training compared with 99 universities providing nursing training. To address the opportunity for reaching out into all areas of both clinical practice and non-clinical services a pathway has been mapped with short courses (minimum qualification as postgraduate certificate; PGCert) and continuing professional development. An established Leadership Competency Framework (Figure 2; NHS Leadership Academy, 2011) has been used to suggest levels of training and education from awareness raising, to student, practitioner and expert practitioner.

Figure 2. HFE Awareness to Expert

The student, practitioner and expert levels are aligned to the International Ergonomics Association competency framework (IEA, 2001). There are 9 Units with detailed Elements and Performance Criteria, for example Unit 5 outlines knowledge and skills to develop a plan for an HFE design or intervention. The first element (5.1) outlines the scope of an holistic view of HFE in developing solutions to firstly (performance criteria 5.1a) identify the relative contribution of organisational, social, cognitive, perceptual, environmental, musculoskeletal or industrial factors to the total problem and secondly (performance criteria 5.1b) consider the impact of legislation, codes of practice, government and industry-based standards on the problem and possible solutions. There will discussions with healthcare professional regulators (e.g. General Medical Council, Nursing & Midwifery Council, Health Care Professions Council) and education providers to explore how HFE principles can be embedded throughout healthcare education.

To benchmark the quality of all HFE training and professional expertise in healthcare it is recommended that the following three criteria (derived from Carayon et al, 2014) should be used (Hignett et al, 2015b):
1. Application of HFE to the design of equipment, medical devices, products, buildings, vehicles and systems.
2. Direct involvement of qualified HFE professionals (registered member of a federated society of the International Ergonomics Association (http://www.iea.cc/about/council.html).
3. Use of HFE knowledge and tools.

5 Discussion and Conclusion

So WHO or WHAT is the elephant? It could be the system and the complexity of service provision by focusing (touching) on one sector (acute, primary care, ambulance, community, ambulatory etc.). It could be an individual problem, task, environment, building, location or project. It could be patients and the range and variety of emotions and behaviours experienced in healthcare interactions from birth to death. By reaching out into clinical practice, this paper has offered ideas and thoughts about integration and also considered both how HFE has been used and future opportunities.

A final personal perspective as a patient is included to augment this narrative. In 2006 I was able to view and experience the healthcare system as a patient (Hignett, 2006). I experienced the frustrations and inadequacies of the UK primary care system by waiting and repeatedly chasing 3 General Practitioners for an investigation referral to a hospital specialist. Finally, after being sent the wrong hospital clinical specialist and further tests I had a diagnosis and was scheduled for a major operation. After the operation my world shrank to just my hospital bed and my main concern was pain management; I wanted to be able to see and reach things, and call for help. Fortunately the hospital had electric beds and I was able to adjust my position independently without calling for nursing assistance. The bed controls were on a single easily accessible panel, but the nurse call control was on a separate cord attached to the wall behind the bed. During the first night the nurse call control fell to the floor and I was unable to retrieve it; I became a noisy patient, calling out to attract attention and ask for the nurse call control to be placed within my reach. For the first 12 hours I received hourly observations: blood pressure, temperature and oxygen saturation. I noticed that disposable covers were used for the thermometer, but not for the pulse oximeter which was taken from patient-to-patient around the ward. I was concerned that placing a finger into the pulse oximeter without a disposable cover or cleaning, could effectively be the same as putting my finger on the previous person’s anus! After the first couple of days my world grew bigger to include other parts of the ward. I started interacting with other patients and felt that they formed a surrogate family who added an extra level of safety to my care by both watching over me (if I was unable to call for help) and helping me to become self-caring faster. I was able to have very basic physiological conversations about recovery, specifically about the function of bladder and bowels.

When I reflect on my immobility, vulnerability and isolation anxiety, I am glad that I was not alone at this time and had ‘someone to watch over me’ (caregivers and other patients). As a patient I had a worm’s eye view and was very self-centered. I was concerned about my pain and well-being, and had relatively little interest or understanding of the ward activities and no interest in the hospital and wider healthcare systems. So perhaps I was the elephant, in seeing only part of the healthcare system. There were local practices and behaviors that were learned and passed on between patients to ‘work the system’ so we were reshaping the elephant by changing the system. The ward staff and other caregivers were probably not aware of these patient behaviors and so it could be argued that caregivers are the blind humans, only seeing part of the elephant. However, I suggest that local teams of caregivers may also have difficulties in seeing other professional perspectives and priorities and the wider healthcare system. Perhaps a better analogy would be to say that the elephant is the entirety of the core business. HFE offers a perspective in understanding the scope of the system (from a macro perspective to recognize that this is an elephant) and stakeholders (for meso and micro interactions) with the diversity of human capabilities and limitations to touch and analyze the elephant.

To conclude, healthcare is a relatively new industrial sector for HFE and there will be many opportunities to optimize human and system wellbeing and performance. Firstly, by integrating safety issues and stakeholders as part of a range of sociotechnical systems (micro, meso and macro) and secondly, by taking a ‘bird’s eye or global view’ of implementation and integration and building on existing systems and structures (e.g. QI). The next 30 years should see a step change for HFE in healthcare as we reach out into clinical practice and offer our HFE knowledge and experience.
6 References


7
Van Cott, H. 1994, “Human Errors: Their Causes and Reduction”. In M.S. Bogner (ed.) Human Error in Medicine, (Hillsdale, NJ: Erlbaum ), 53-65.