Human factors and ergonomics

Human factors and ergonomics in healthcare is an important discipline that considers both the physical and mental characteristics of healthcare workers, as well as the complex interactions within which organisations exist.

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A working party convened by the Association of Anaesthetists and Difficult Airway Society recently published a twin set of guidelines on human factors and ergonomics (Kelly et al, 2023a,b). According to the International Ergonomics Association (2023), human factors ergonomics is:

> **'the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimise human wellbeing and overall system performance'.**

Simply put, it aims to make it easy for workers to 'do the right thing' and difficult, preferably impossible, for them to 'do the wrong thing'.

Historically, human factors and ergonomics in healthcare has focused too heavily on the non-technical skills and aspects of human performance. While non-technical skills, such as team working, decision making, situational awareness and task management, are important, human factors and ergonomics itself is a much broader discipline, which goes well beyond human performance. Human factors and ergonomics account for the complexity of the organisations within which risk must be managed, and the broader contexts within which organisations exist. It is therefore encouraging that we are starting to take a wider view that better incorporates the complex interfaces within 'sociotechnical systems'.

The increased interest in human factors and ergonomics in healthcare is in no small part thanks to the active engagement by Martin Bromiley following a personal tragedy (Bromiley, 2015), who subsequently founded the Clinical Human Factors Group, a charity working to make healthcare better. Their mission statement includes helping to build reliability into healthcare, promoting human factors science, and learning from success as well as failure. Human factors strategies can be categorised into four domains (design, barriers, mitigations, education and training) according to the hierarchy of controls model (International Ergonomics Association, 2023). These four domains are depicted as a pyramid according to their likely effectiveness. Design (eg environment, systems and equipment) is likely to be the most effective and is the base of the pyramid. 'Designing out' the chance of an error occurring reduces the requirement for exceptional human performance that is commonly relied upon in healthcare. The design of any new healthcare system or sub-system is a chance to improve patient safety, efficiency and staff wellbeing. Human factors and ergonomics experts should be centrally involved in hospital and healthcare system design.

The importance of design

Well-designed working environments are vital in the pursuit of safer healthcare. This includes, but extends well beyond, engineering physical safeguards to the complex interactions between the social and technical aspects of the system. The dynamic interplay between human operators, their equipment and the working environment requires that we also consider, and where necessary alter, working patterns and flows within those spaces. This process forms the foundation of safety within a system, and qualified human factors and ergonomics professionals and experts must be central to these efforts. It is important to recognise human factors and ergonomics as a discipline in its own right and that successful implementation will require partnerships between human factors and ergonomics

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professionals and clinician experts pioneering efforts in this field, as well as investment. By using a human factors approach in this way, the design of workspaces can be optimised. In the case of anaesthesia, for example, this might include everything from the architectural aspects of theatre layout and the positioning of medical gas outlets, suction, laminar flow hoods and electrical sockets, to the way in which the operating theatre team moves, flows and works through the space each day (Bailey et al, 2021).

Human factors and ergonomics professionals should also be involved in the design and manufacture of medical equipment. International standards, as well as those from the UK Medicines and Healthcare products Regulatory Agency, require medical equipment manufacturers to incorporate a human factors usability engineering assessment into their product development to detect potential user errors. Despite this, many existing medical devices continue to exhibit design flaws which create risks to patient safety (Longstaffe, 2021). Manufacturers should perform more thorough human factors assessments, using trained practitioners, from the earliest stages of product design and development (indeed at a stage earlier than is mandated at present), and at every stage of the product development lifecycle thereafter. This would enable improved product design and correction of any design flaws before the product is marketed.

Reducing errors

Design strategies are followed in order by barriers (which trap errors), mitigations (which reduce the consequences of errors) and education and training. The contributory role of production pressures in industrial accidents are well recognised. Within healthcare, this feature is unavoidable but its presence and potential negative impacts must be guarded against. Mistakes are more likely if staff have to rush while working, or are anxious as a result of potentially unachievable workloads. For anaesthetists, this might involve difficult, complex operations, sick patients, the skill mix of the theatre team or routine operating theatre lists with large numbers of cases. Therefore, operating theatre list planning, scheduling and staffing needs to take these issues into account, with additional time allocated where necessary and the skill mix adjusted. Adequate time should be scheduled for a comprehensive team brief at the start of an operating theatre list with the whole team present.

In January 2023, the Centre for Perioperative Care (2023) published revised National Safety Standards for Invasive Procedures, designed to reduce misunderstandings or errors and to improve team cohesion. The standards re-launch the World Health Organization checklist and mandate key stop moments when the standard pathway is confirmed and patient-specific details clarified. This improves both patient safety and team-working.

The original National Safety Standards for Invasive Procedures were published in 2015, in order to help NHS organisations provide safer care and to reduce the number of patient safety incidents related to invasive procedures in which surgical never events can occur. Adequate time should also be scheduled at the end of the operating list for a team debrief involving the whole theatre team. This allows staff to reflect together on what went well, discuss practical ways of improving the working environment and practices, and provides a system for escalating concerns. When performed well, these debriefs can improve team morale and interpersonal working relationships, and promote ‘flattening of the hierarchy’ within the team. While some hierarchy or authority gradient within a team is necessary to enable effective leadership, there are assertiveness tools that can be used by team members to help them speak up when they feel that patient safety is at risk. Leaders should strive to create an environment of psychological safety where all members of the team are supported to raise concerns without fear of negative comments or adverse consequences.

Increasing awareness of human factors and ergonomics

One of the limitations of the Association of Anaesthetists and Difficult Airway Society guidelines was that there were relatively few human factors and ergonomics specialists involved in the work. The profession of human factors and ergonomics is chartered in the UK and is conferred by the Chartered Institute of Ergonomics and Human Factors

Key points

- Human factors and ergonomics in healthcare consider both the physical and mental characteristics of healthcare workers, as well as the complex interactions within which organisations exist.
- Human factors and ergonomics aim to make it easy for healthcare workers to 'do the right thing' and difficult for them to 'do the wrong thing'.
- The foundation of safety depends on considering, altering and improving the dynamic interplay between healthcare workers, their equipment and the environment.
- Human factors strategies can be categorised into four domains (design, barriers, mitigations, education and training) according to the hierarchy of controls model.
- While there are excellent examples in the NHS, human factors and ergonomics expertise currently has difficulty integrating its experts into healthcare, and trusts should be encouraged to have dedicated, qualified human factors and ergonomics teams.

to members who fulfil certain criteria. This includes 'having a high level of qualification and experience and being able to demonstrate continuing professional development,' and operating under a code of conduct.

However, human factors and ergonomics expertise currently has difficulty integrating its experts into healthcare (Perry et al, 2021) and there are far too few practitioners employed by trusts in the NHS (Shorrock, 2018). We desperately need to seek out and collaborate with human factors and ergonomics practitioners; there are some great examples of their fantastic contribution to the NHS and it would make sense to have dedicated, integrated, qualified human factors teams.

Conclusions

Human factors – as defined in the new Association of Anaesthetists' guidelines – is now firmly on the agenda. It has taken a long time to arrive at this point, with healthcare professionals beginning to understand practitioners in the context of the systems within which they work. There is still a long way to go but in this new casting, and the appreciation of complexity and the need for partnerships between healthcare professionals and experts in human factors and ergonomics, we are moving in the right direction.

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