The Big Issue: ergonomics in healthcare education

R. Hubbard
School of Pharmacy and Life Sciences, Robert Gordon University

K. Regan
School of Pharmacy and Life Sciences, Robert Gordon University

A. Strath
School of Pharmacy and Life Sciences, Robert Gordon University
a.strath@rgu.ac.uk

H. Vosper
School of Pharmacy and Life Sciences, Robert Gordon University
h.vosper@rgu.ac.uk

Introduction

"To err is human, to cover up is unforgivable, and to fail to learn is inexcusable." (Liam Donaldson, speaking at the launch of the World Alliance for Patient Safety - Washington DC, 2004).

Ergonomics is both a science and a practice. The science of ergonomics is the study of human interaction with the systems in which they operate. Classically, these have been considered as work systems (the word is derived from the Greek 'ergon' – work), but increasingly the discipline has expanded to include leisure activities. The theories, principles and tools developed from the scientific study of human-system interaction are applied in the practice of ergonomics, which seeks to optimise overall system performance, including the improvement of human wellbeing (Wilson, 2000). Ergonomics draws on a number of different domains, including psychology, anatomy and anthropometry, engineering and design. This has led to something of a struggle for it to be seen as a distinct discipline, although this battle has at last been won with the granting of a Royal Charter to the Institute of Ergonomics and Human Factors (now the Chartered Institute) in recognition of the contribution of the discipline to society as a whole. If you haven't heard of ergonomics, you may be more familiar with the term 'human factors': from a discipline perspective, the terms are considered synonymous, but we believe that sometimes they are used differently, and this is particularly important with respect to healthcare.

Within the discipline, there are generally considered to be three specialised domains, including physical, cognitive and organisational (or socio-technical) ergonomics. Physical ergonomics is concerned with the layout of the working environment, and the impact this has on physical activity. Poor design can make it difficult for people to carry out tasks and can have long term effects on health and wellbeing – work-related musculoskeletal disorders have enormous economic impact. Cognitive ergonomics is concerned with mental processes and includes elements such as decision-making and situational awareness. The organisational specialisation considers the whole system, including the policies and processes impacting on that system. This specialisation includes team-working, crew resource management (CRM), communication and quality management.

What is the relevance of this to healthcare? Ergonomics has been gradually gaining a foothold over the past 20 years, but recent high-profile events have underlined the fact that healthcare failures are invariably *systems* failures and that the systems approach offered by ergonomics is necessary if performance is to be improved.

Landmark events

In 1999, the Institute of Medicine published the document 'To err is human: building a safer health system.' This document opened with the startling claim that between 44,000 and 98,000 patients die each year in American hospitals as a result of *preventable* medical errors. The report also recognised that errors with serious consequences were most likely to occur in high-pressure environments such as intensive care, operating theatres and emergency rooms. The costs (in addition to the unnecessary loss of life) ran into billions of dollars, and other impacts included loss of trust in the healthcare system and reduced patient satisfaction. In the opinion of the authors, this resulted from the decentralisation of healthcare and its resulting fragmentation. The delivery system had become a 'non-system' (or perhaps a series of smaller systems which failed to interact effectively).

Similar outcomes have also been seen in the UK in recent years, with perhaps the most notorious failings being those observed at Mid-Staffordshire, captured in the Francis Report (2013). Patients received substandard care, but the report also described a 'combination of circumstances' that allowed the situation to persist over a number of years. These circumstances included a system of governance that not only failed to identify many of the problems, but also did not act on the occasions when failings were identified (Martin and Dixon-Woods, 2014).

It is important to acknowledge that practitioners who make mistakes are not (usually) acting in a deliberately negligent manner, neither is their behaviour outwith norms (Dekker, 2014). When an error leads to patient harm, the practitioner has often been 'unlucky' in the sense that – under this particular set of circumstances – the outcome proved negative. Errors are an inevitable consequence of complex systems, in the same way that risk is an inevitable by-product of healthcare complexity. Attempts to find a single cause of an incident fail to recognise these issues and represent a lost opportunity to improve system reliability.

Healthcare organisations need to strive for high reliability, a feature of high risk industries which, despite elevated risk, have a low rate of adverse incidents. These include the nuclear and aviation industries. High reliability organisations have a number of characteristic features (Hopkins, 2009; Sutcliffe, 2011):

- They are resilient: errors do occur, but they do not disable the system. This approach recognises that individual failings will always occur, but system design prevents these errors from resulting in an unsafe outcome
- There is an open reporting culture and lessons are learnt from failures

- However, reporting is not the only source of safety information: other data is collected, analysed and triangulated with the results of reporting to support the organisation in recognising what are known as ‘signals’ – events which may precede more serious outcomes
- There is a realistic awareness of risk
- Their staff are appropriately trained
- They are wary of success, recognising that long periods of smooth operation can breed complacency, and they are vigilant against this
- Such organisations recognise that adverse outcomes have a negative impact on staff as well as clients, and have structures in place to prevent the phenomenon of “second victim” (Dekker, 2013)

Systems-based ergonomics approaches provide frameworks for supporting the development of high reliability. They effectively offer a mechanism for dealing with complexity. Systems thinking is not something which comes naturally to most people – humans are not programmed to understand effects that are delayed (or several derivatives from) causative events. This probably results from our information processing ability. Current theories suggest that there are two such systems, automatic and analytic. The automatic (unconscious) system is rapid, but prone to bias and tends to be engaged when we are working under familiar conditions. When an unfamiliar situation is encountered, we need to actively engage the analytic system. This system is only capable with dealing with a single piece of information at a given time, and can result in a condition known as fixation, which can be disastrous if other relevant information is being ignored (Mitchell, 2013). This was a major contributor to the outcome in the case of Elaine Bromiley (see below). Systems frameworks (and their ongoing use) allow the development of habits and practices that support success and make failure less likely.

Ergonomics in healthcare

Until relatively recently, healthcare ergonomics focussed almost entirely on hospital staff, with interventions designed to reduce occurences of work-related musculoskeletal disorders. In recent years, it has been appreciated that a systems approach can resolve some of the issues around patient safety, a development enhanced by the establishment of the Clinical Human Factors Group (CHFG). The CHFG describes itself as ‘a broad coalition of healthcare professionals, service users and managers who… place an understanding of human factors at the heart of improving… practice.’ Martin Bromiley, an airline pilot, established the group in response to the loss of his wife who died as a result of a mismanaged ‘can’t intubate, can’t ventilate’ situation during routine surgery. He brought his considerable experience of aviation human factors to bear in a different context, and the science of patient safety owes much to his willingness to turn a personal disaster into a publically-owned lesson in systems understanding. Note that healthcare generally uses the term ‘human factors’ rather than ergonomics.

Physical ergonomics has always played an important role in aviation safety. Cockpit layout is very carefully considered: switches that operate wheels are wheel-shaped and are moved downwards to select ‘wheels down' for example. These relationships are maintained on all flight decks, so that there is minimal risk of negative transference when operating different aircraft. Switches which must not be accidentally operated are guarded, and often located out of the immediate reach envelope. Many of these ergonomic developments were shaped by World War II, which provided a steep learning curve with respect to the link between human error and adverse outcomes in aviation (Fitts and Jones, 1947). The late 1970s saw a return to ergonomics, but this time from a cognitive and organisational perspective (Flin *et al.*, 2002). The 1977 Tenerife disaster involved a collision between two Boeing 747s on the runway at Los Rodeos airport in the Canary Islands. Although the causality was complex, the final contributory factor was the KLM captain's decision to take off without a clearance from Air Traffic Control (ATC) at the same time that the PanAm 747 was taxiing along the runway. The accident investigation concluded that the accident was a result of a breakdown in communication between the different members of the flight crew and between the flight crew and ATC. Notably, the KLM flight engineer had correctly interpreted the air traffic transmissions to mean that the runway was not clear, and he drew this to the attention of the captain. The KLM take-off was continued, with the loss of 583 lives in what is still recognised as the worst air disaster in history. 18 months later, in December 1978, United Airlines flight 173 was making an approach to Portland International Airport in the USA, when the crew experienced a potential landing gear failure. The captain opted to enter the hold to give them time to rectify the issue. It appears that the captain became fixated on the problem at hand, and repeatedly ignored the concerns of the first officer and the flight engineer regarding the fuel situation. In the end, the crew had to make a forced landing in a Portland suburb, with the loss of ten lives. The National Transportation Safety Board (NTSB) recognised that communication and team-working failures (particularly the 'command hierarchy') were major contributors not only to this accident, but to Tenerife and a number of other events. The NTSB suggested that training in these non-technical skills had the potential to significantly improve safety, which led to the birth of CRM, or crew resource management, which is now a mandatory element of aircrew training.

There are significant parallels between aviation and healthcare, and there has been an increasing recognition that poor non-technical skills are often at the heart of medical errors. Certainly there are powerful status hierarchies in medical teams (most notably between doctors and nurses; World Health Organization, 2009) and these often prevent people from speaking out when they see a problem. This was one of the issues in the Elaine Bromiley case: the nurses had recognised that the situation was critical and yet struggled to convey their concerns to the doctors. CRM training is therefore seen as a valuable tool to support patient safety. From an ergonomics perspective, CRM falls primarily into the cognitive and organisational domains, and there has perhaps been a focus on these domains at the expense of physical ergonomics. As Martin Bromiley himself observes, the initial focus of the CHFG was on teamwork, a "narrow focus made worse by my own perspective" (the particular circumstances that led to the loss of his wife). The focus on cognitive and organisational ergonomics and the choice of the term 'human factors' has perhaps led to the belief that human factors is different from ergonomics. It is important for healthcare that human factors training draws on all domains if patient safety is to be maximised.

Embedding ergonomics approaches

The CHFG has achieved considerable success in influencing policy with regard to human factors in healthcare, especially with regard to using commissioning as a lever to encourage engagement with human factors (CHFG, 2014). Across the NHS, patient safety depends very much on empowering individuals to recognise problems and to feel comfortable about taking steps at a local level to improve performance. Application of quality improvement methodology is part of the NHS Scotland Quality Strategy, and supports frontline staff in implementing sustainable improvement. However, while quality improvement may draw on some human factors theories, in the words of Mary Dixon-Woods "QI projects have an important role, but they cannot solve all patient safety problems." She likens it to 'swatting mosquitoes one by one' when what is needed is a co-ordinated effort to 'drain the swamp.'

A critical step in 'swamp draining' is ensuring that new healthcare professionals are trained in human factors/ergonomics before they enter the workplace. In 2009, the World Health Organization published a patient safety curriculum guide for medical schools, which explicitly articulates the importance of human factors training. November 2013 saw the publication of the National Quality Board Human Factors Concordat. The signatories to the concordat made a number of commitments relating to the embedding of human factors in healthcare. One of these was the inclusion of 'human factors principles and practice in core education and training curricula for health professionals.' Signatories relevant to healthcare education included the General Medical and Nursing and Midwifery Councils and Health Education England. Interestingly, there is very little in terms of direct reference to human factors within any of the education standards, although it is implicitly referred to in terms of expectations that graduates of such programmes will be proficient in team-working and communication skills, for example. Furthermore, we are not yet at the stage where educators can be satisfied that graduates are leaving university with the competencies necessary to underpin patient safety in the workplace (Nie et al., 2011; Ginsburg et al., 2013).

Improving human factors education in undergraduate training programmes requires staff training and development and cross-disciplinary sharing of practice. In this issue, Hubbard *et al*. provide an example of how an existing teaching and learning activity may be developed to include exploration of ergonomics methods and applications.

References

CLINICAL HUMAN FACTORS GROUP, 2014. *Human factors informed commissioning: adding value to NHS productivity, efficiency, effectiveness and quality.* [online]. North Marston: CHFG. Available from: http://chfg.org/news/human-factors-informed-commissioning [Accessed 8 July 2015].

DEKKER, S. 2013. *Second victim*. Boca Raton: CRC Press.

DEKKER, S. 2014. *The field guide to understanding human error.* 3rd ed. Farnham: Ashgate.

HOPKINS, A. 2009. *Learning from high reliability organisations*. Sydney: CCH, Australia.

FITTS, P.M. and JONES, R.E., 1947. *Analysis of factors contributing to 460 "pilot error" experiences in operating aircraft controls (Report No. TSEAA-694-12).* Dayton, OH: Aero Medical Laboratory, Air Material Command, USAF.

FLIN, R., O'CONNOR, P., and MEARNS, K., 2002. Crew resource management: improving team work in high reliability industries. *Team Performance Management,* 8(3/4), pp. 68-78.

FRANCIS, R., 2013. *The Mid Staffordshire NHS Foundation Trust Public Enquiry.* [online]. Norwich: TSO. Available at: http://www.midstaffspublicinquiry.com/report [accessed 08/07/15]

Ginsberg, L.R., D. Tregunno, P.G. Norton. 2013. Self-reported patient safety competence among new graduates in medicine, nursing and pharmacy. *BMJ Quality and Safety*, 22, pp. 147-154.

INSTITUTE OF MEDICINE, 1999. *To err is human: building a safer healthcare system*. [online]. Washington, DC: National Academy Press. Available from: http://www.nap.edu/books/0309068371/html/ [Accessed 8 July 2015].

MARTIN, G.P., and DIXON-WOODS, M., 2014. After Mid-Staffordshire: from acknowledgement, through learning, to improvement. *BMJ Quality and Safety*, 23, pp. 706-708.

MITCHELL, P., ed., 2013. *Human factors in healthcare: a course handbook*. [online]. Cove: Swan and Horn. Available from: http://patientsafety.health.org.uk/resources/safer-care-human-factors-healthcare-0 [Accessed 8 July 2015].

NATIONAL QUALITY BOARD, 2013. *Human factors in healthcare. A concordat from the National Quality Board.* [online]. Redditch: NHS England. Available from: http://www.england.nhs.uk/wp-content/uploads/2013/11/nqb-hum-fact-concord.pdf [Accessed 8 July 2015].

NIE, Y., et al., 2011. Patient safety education for undergraduate medical students: A systematic review. [online]. *BMC Medical Education,* 11:33.

Available from: http://www.biomedcentral.com/1472-6920/11/33 [Accessed 8 July 2015].

SUTCLIFFE, K.M. 2011. High Reliability Organisations (HROs). *Clinical Anaesthesiology,* 25(2), pp. 133-144.

WILSON, J.R., 2000. Fundamentals of ergonomics in theory and practice. *Applied Ergonomics,* 31, pp. 557-567.

WORLD HEALTH ORGANIZATION, 2009. *Human factors in patient safety: a review of topics and tools. WHO/IER/PSP/2009.05.* [online]. Geneva: WHO. Available from: http://www.who.int/patientsafety/research/methods_measures/human_factors/human_factors_review.pdf [Accessed 8 July 2015].