Poole Hospital NHS
NHS Foundation Trust

Human Factors Study Day Pre Course Reading

Introduction

The origin of Human Factors training is most often traced to a NASA workshop in 1979 after a spate of fatal air disasters caused by distraction, lack of communication, poor leadership and behaviour. The workshop focused on improving air safety by reducing human error. The workshop was convened to consider research undertaken by NASA, which indicated that the majority of aviation accidents were caused by easily identifiable failures in the cockpit, including interpersonal communication, leadership, and decision making.

Learning from Aviation

Human Factors in healthcare has been strongly influenced by a very similar concept in aviation known as Crew Resource Management. This research has been ongoing for more than 30 years and the lessons learnt are transferable to healthcare and the issues faced in both industries have a lot of similarities.

It has been recognised over the past several decades that safety and efficiency require a "team effort". Historically, the Captain was considered the most important individual involved in a flight. It was felt that so long as they possessed technical and procedural competence, then flight safety would be assured.

As aircrafts grew larger and operations grew more complex, a co-pilot was added to the flight crew. Those first co-pilots were considered redundant pilots. Their function was simply to provide an operational backup in the extremely rare condition that the Captain for any reason became incapacitated and to provide support and reduce the workload for the Captain if they were asked to do so. Initially most Captains did not particularly like the idea and for several years the co-pilot did little more than make the flight plans for the Captain to approve and sign. Their main job was to handle the radio communications.

In the 1980's as accidents and incidents were evaluated, it became clear that the technical ability of the crew was very seldom the sole cause of the accidents.

It appeared that frequently there was:

- Poor communication within the cockpit.
- Crew interface problems that included:
    - Inadequate leadership.
    - Poor decision-making.

Between 60 – 80% of aircraft accidents in commercial air transport have been attributed to the flight crew. Despite improvements in the overall safety record, neither industry nor regulatory efforts had been able to change the disheartening and unsatisfactory relationship between accidents and the operational behaviour of the cockpit crew.

As a result of much investigation by virtually all aspects of the industry, the Cockpit resource management concept developed. This has since grown, been refined and expanded and is now called Crew Resource Management. This was introduced in 1993, and was reinforced in 1995 for recurrent training.

Accidents caused by Human Factors in industry

The lessons learnt in the aviation industry were soon found to be equally applicable in a wide range of other industries in which people perform safety critical tasks. Most of these industries had high profile accidents that became pivotal moments in the introduction and application of human factors training.

The application of human factors in healthcare began to be studied in earnest from 2000, with a number of pilot projects in a range of clinical settings. The case of Elaine Bromiley in 2005, lead to the development and more widespread uptake of human factors in healthcare. Martin Bromiley, Elaine’s husband, was a pilot trained in human factors and went on to found the Clinical Human Factors Group.

Human Factors training:

- Provides awareness of the interactions among humans and their relationship with machines, procedures, the environment and other people
- It applies theory, principles, data and methods to optimise human well-being and overall system performance
- Imparts an understanding of human capabilities and limitations
- Relates to people in their living and working situations

Commonly Asked Questions about Human Factors in Healthcare

What does the term “human factors” mean?

Human factors apply where ever humans work. Human factors acknowledge the universal nature of human fallibility. The traditional approach to human error might be called the “perfectibility” model that assumes that if workers care enough, work hard enough, are sufficiently well trained and punished for their mistakes then errors will be avoided. Our experience, and that of international experts, tells us that this attitude is counter-productive and does not work.

Why human factors in health care important?

Human factors are major contributors to adverse patient safety incidents. However, the health care system can be made safer by recognising the potential for error, and by developing systems and strategies to learn from mistakes so as to minimise their occurrence and effects.

Is it possible to manage human factors?

Yes, management of human factors involves the application of proactive techniques aimed at minimising and learning from errors or near-misses. A work culture that encourages the reporting of adverse events and near-misses in health care allows the health care system and patient safety to improve.

Since the mid-1980's, aviation has accepted human fallibility as inevitable and, rather than demand constant perfection that is not sustainable and publicly punishing error, this industry has designed systems to minimise the impact of human error. The aviation safety record is now a testament to this approach - despite an average of 10 million take-offs and landings annually, there have been less than ten fatal crashes a year worldwide in commercial aviation since 1965, and many of these have occurred in developing nations.

Conceptual Model of Human Factors

SHELL Model

It is helpful to use a model to aid in the understanding of Human Factors, as this allows a gradual approach to comprehension. One practical diagram to illustrate this conceptual model uses blocks to represent different components of Human Factors.

The model can then be built up one block at a time, with a pictorial impression being given of the need for matching the components. It is called the SHELL concept (the name being derived from the initial letters of its components - Software, Hardware, Environment, Liveware). The following interpretations are suggested:

Software = procedures, guidelines, rules and regulations.

Hardware = equipment, ergonomics.

Environment = the situation in which the S-H-L system must function e.g. noise, lighting, temperature, space, economic and political climate around healthcare.

Liveware = human

In this model the match or mismatch of the blocks (interface) is just as important as the characteristics of the blocks themselves. A mismatch can be a source of human error. It should be mentioned that this building block diagram is only intended as a basic aid to understanding Human Factors.

Liveware – You

In the centre of the model is a person, the most critical as well as the most flexible component in the system. People are subject to considerable variations in performance and suffer many limitations, most of which are now predictable in general terms.

The edges of this block are not simple and straight, and so the other components of the system must be carefully matched if breakdown are to be avoided.

In order to achieve this matching, an understanding of the characteristics of this central component is essential. Some of the more important characteristics are the following:

- Variations in performance & limitations: This incorporates general health, physical fitness, and co-existing medical problems. These may influence physical strength and mobility.
- Physical size and shape: This considers the design of the workplace and of most equipment ranging from a drip stand to an operating table, a vital role is played by body measurements and movements, which will vary according to age and ethnic and gender groups. Decisions must be made at an early stage in the design process, and the data for these decisions are available from anthropometry and biomechanics.
- Physical needs: This incorporates people's requirements for food, water and oxygen. Data is available from physiology and biology.
- Input characteristics: Humans have been provided with a sensory system for collecting information from the world around them, enabling them to respond to external events and to carry out the required task. But all senses are subject to degradation for one reason or another and the sources of knowledge here are physiology, psychology and biology.
- Output characteristics: Once information is sensed and processed, messages are sent to the muscles to initiate the desired response, whether it is a physical control movement or the initiation of some form of communication. Acceptable control forces and direction of movement have to be known. Biomechanics, physiology and psychology provide such knowledge.

- Information processing: This human capability has severe limitations. Poor instrument and warning system design has frequently resulted from a failure to take into account the capabilities and limitations of the human information processing system. Short and long-term memory is involved, as well as motivation and stress. Psychology is the source of background knowledge here.
- Environmental tolerances: Temperature, humidity, noise, time of day, light and darkness can all be reflected in performance and also in well-being. A boring or stressful working environment can also be expected to influence performance. Information is provided here by physiology, biology and psychology.

The Liveware is the hub of the SHELL model of Human Factors. The remaining components must be adapted and matched to this central component. We will now look at the interface between the Liveware/Human and the other components.

Liveware - Software Interface

This encompasses humans and the non-physical aspects of the system such as:

- Document design i.e. checklist layout (held in one hand/flip over etc).
- Symbology and computer programmes. Standardisation of symbols and colours for lights and warnings such as Red for emergency and Green for go.
- Procedures i.e. SOPs, normal, abnormal or emergency, drills for critical care situations. Are they logical, will they work, are they clear and unambiguous, can you understand them.

- Training manuals i.e. content and design.
- Rules and regulations i.e. organisation and relevant statutory body.

Liveware-software problems are conspicuous in accident reports, but they are often difficult to observe and are consequently more difficult to resolve (for example, misinterpretation of checklists or symbology, non-compliance with procedures, etc.)

Liveware - Hardware Interface

This interface is the one most commonly considered when speaking of human to machine/equipment systems (ergonomics):

- The design of patient beds, operating tables, work stations to fit the characteristics of the human body.
- Of displays to match the sensory and information processing characteristics of the user for example the colour of warning lights in patient monitoring equipment.
- Work space in the operating theatre is often very limited so needs to be well-designed to avoid collisions and cramping.

The user may never be aware of an L-H deficiency, even where it finally leads to disaster; this is because although the natural human characteristic of adapting to L-H mismatches will mask such a deficiency, they will not remove its existence.

This constitutes a potential hazard to which designers should be alert. With the introduction of computers and advanced automated systems this interface has repositioned itself at the forefront of Human Factors endeavours.

Liveware - Environment Interface.

The human environment interface was one of the earliest recognised in flying but perhaps not so clearly identified in healthcare.

A main area for concern in healthcare is the problems associated with disturbed biological rhythms and related sleep disturbance and deprivation as a consequence of shift work. The healthcare system also operates within the context of broad political and economic constraints and local cultural influences, and those aspects of the environment will interact in this interface.

Although the possibility of modifying these influences is sometimes beyond Human Factors practitioners, their incidence is central and should be properly considered and addressed by those in management with the possibility to do so.

Liveware - Liveware Interface

This is the interface between people. Training and competency testing has traditionally been done on an individual basis. If each individual team member was fully competent to carry out their tasks then it was assumed that the team consisting of these individuals would also be proficient and effective. This is not always the case however and for many years attention has increasingly turned to the breakdown of teamwork.

Cleaning staff, porters, nurses, doctors and administrators function as groups and group influences play a role in determining behaviour with performance. In this interface, we are concerned with leadership, co-operation, teamwork and personality interactions. Staff/management relationships are also within the scope of this interface, as organisational culture, climate and operational pressures can significantly affect human performance.