Chapter 1

Introduction to Human Factors

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In this chapter:

- An introduction to the principles and aims of human factors
- Consideration of definitions, terminology and models related to human factors
- How human factors can influence patient safety

Introduction

'Human factors' is a term that most pre-hospital providers will have heard of, as it is being increasingly referred to in healthcare. Since the 1940s, human factors principles and specialists have become embedded in a range of high reliability and safety-critical industries such as mining, oil and gas extraction, construction, military, aviation, rail and nuclear power generation. Healthcare has noticed the benefits achieved by these industries in improving reliability and safety, and has therefore been exploring and evaluating ways to implement human factors principles. Healthcare is in the infancy of its understanding and application of human factors, and the same can be said specifically for the pre-hospital world that we are interested in. There are a few challenges associated with applying human factors approaches, including gaining a shared understanding of what it is. Therefore, this book offers an introduction to the topic of human factors, outlining some of the key principles and how they can be considered and applied in paramedic practice.

What is Human Factors?

Today's understanding of human factors has its origins in military aviation from around the time of World War II, which is discussed further in Chapter 2. Since then, the concept has grown and been applied in many other high-risk industries. Human factors is described as 'a science at the intersection of psychology and engineering' (Russ et al, 2013), which encourages a systems approach to consider a range of aspects related to human work. These aspects include how humans interact with each other and with other elements of the system, for example, the tools, technology, processes and tasks that are required to do the work. It is an approach that takes account of the capabilities and limitations of humans, in addition to cognitive, physical and organisational factors within the workplace (International Ergonomics Association, 2020). It uses this understanding of human performance in different circumstances to design the work environments, procedures, tasks and equipment to make it easy for people to use and interact with, instead of people having to adapt to poor design. Human factors therefore aims to improve the 'fit' between people and their environment to achieve a safer, more productive and effective workplace. In the first instance it would look to design the work system to fit the human, only attempting to make the human fit the work (through selection or training) when the first approach is not possible (Dul et al, 2012).

The International Ergonomics Association (IEA) proposes two interrelated aims of human factors:

- improve system performance (for example, safety, efficiency and productivity)
- optimise human well-being (for example, health and safety, experience and satisfaction).

The linked relationship between these aims is crucial and is illustrated in Figure 1.1. If system performance is improved, a benefit in human (staff and patient) well-being can be achieved. Equally, if well-being is optimised, positive results will be seen in overall system performance.

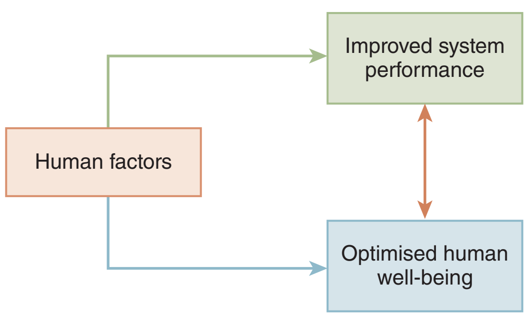

Figure 1.1 – Twin aims of human factors

In healthcare there are a range of views and thoughts on what human factors is. This is partly due to the breadth of the discipline and also the development that is taking place in relation to healthcare professionals' understanding of the subject. You may find the heading of this section odd – 'what *is* human factors?', not 'what *are* human factors?'. To use 'is' makes it clearer that we are predominantly considering human factors as a recognised discipline with defined principles and approaches to cover all of the above aspects. The use of 'are' to describe human factors may encourage the belief that it is an approach only related to factors associated with human behaviour. In response to this developing shared understanding, human factors is increasingly being recognised as a potential way of adding value to existing programmes and initiatives in healthcare, although it is principally being used at the moment to assist with reducing avoidable harm.

Definitions

Various definitions of human factors have been proposed, although the IEA offers the following definition which is a commonly cited description that can be applied across a range of industries:

> Ergonomics (or human factors) 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 well-being** and overall **system performance**.
>
> (IEA, 2020)

As this is a rather lengthy definition with several elements and points, it can be helpful if we break it down to consider further (see Table 1.1).

Alternative Definitions

The Clinical Human Factors Group (CHFG) offers a definition that also highlights the design for the human work aspect of the discipline, while specifically considering the limitations and characteristics of people. They also introduce the concept of the socio-technical system, a term which captures the complexity of modern healthcare delivery.

> Human Factors (also called ergonomics) is a discipline that considers both the physical and mental characteristics of people as well as the organisational factors or wider socio-technical system. It is the application of scientific methods to the design and evaluation of tasks, jobs, equipment, environments and systems to make them more compatible with the needs, capabilities and limitations of people.
>
> (Clinical Human Factors Group, 2020)

These definitions attempt to cover all the main aspects, aims and outcomes of human factors, hence their intricacy. However, it may be helpfully captured well with this simple, concise definition:

> Understanding the interactions between people and all other elements within a system, and design in light of this understanding.
>
> (Wilson, 2014)

Socio-technical system – synergistic combination of humans, machines, environments, work activities and organisational structures and processes (Carayon et al, 2015).

Table 1.1 – Breakdown of IEA definition of human factors/ergonomics

IEA Definition Key Point	Interpretation
Scientific discipline	An organised theoretical knowledge of a particular topic or a field of study.
Interactions among humans	Can include the interactions between healthcare staff and patients, and between healthcare staff in the workplace. Non-technical skills such as communication, teamwork and decision making can play an important role in these interactions.
Interactions among ... other elements of a system	A system is an interconnected network of elements that function together to produce an outcome or product. The other elements (in addition to the humans) are the tools and equipment, the tasks, the physical, social and cultural environments, and organisational policies and procedures influencing work.
The profession that applies ...	Human factors is also a recognised regulated profession with many registered human factors experts applying the principles in safety-critical industries (although not many in healthcare).
To design	This is one of the key points. It is fundamental that any understanding gained from the analysis of system interactions is used to design or strengthen the system to achieve improvements.
Optimise human well-being	One of the 'twin aims'. An understanding that optimal design of work systems can lead to staff feeling safe, supported and valued at work with increased job satisfaction and enjoyment. In the context of healthcare, the well-being of the patient can also be considered.
Overall system performance	The second 'twin aim'. If human factors principles can be applied to the design of workplace tasks and processes, the other outcome will be improved overall system performance. In healthcare, this could lead to safer care and better outcomes for patients.

Terminology

In these definitions you will see that 'ergonomics' is stated as an alternative term for human factors, and as you read more widely on this topic you will find that the terms human factors and ergonomics are both used in literature and practice. The Chartered Institute of Ergonomics and Human Factors (CIEHF) explains that, as the discipline evolved from the 1940s, some variation of terminology occurred in different countries. The CIEHF states that the terms human factors and ergonomics are viewed as the same discipline by the profession, therefore are synonymous and can be