

# Using Human Factors Science to Improve Quality and Safety of Healthcare

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## LEARNING OBJECTIVES

1. Describe fundamental human factors (HF) concepts and approaches.
2. Outline key HF priorities that can be applied in diverse areas of healthcare.
3. Explain the multifunctional potential of the Systems Engineering Initiative for Patient Safety (SEIPS) framework for problem-solving, redesign, and improvement.

## INTRODUCTION

Human factors (HF), also known as ergonomics, is the study of how humans interact with a system. In a healthcare setting, the study of HF seeks to optimize the quality and performance of healthcare systems while enhancing the well-being of both the individuals receiving care and the professionals providing it. Multiple agencies, including the World Health Organization and professional associations, have highlighted the urgent need to integrate HF-based science for improving the quality and safety of healthcare.<sup>[1,2]</sup>

There are clear synergies between and quality improvement (QI) and HF science, having different but potentially complementary system-based approaches. HF science explores a problem by placing humans as the central component of system, focusing on their interactions with each other and the wider work system, then redesigning tasks,

interfaces, and work processes. QI science generally aims to define care processes and implement changes by testing different approaches to achieve a desired outcome and make processes more reliable (which is not always analogous to making them safer). Exploring synergistic collaboration should be a priority to add value to both approaches.<sup>[3]</sup>

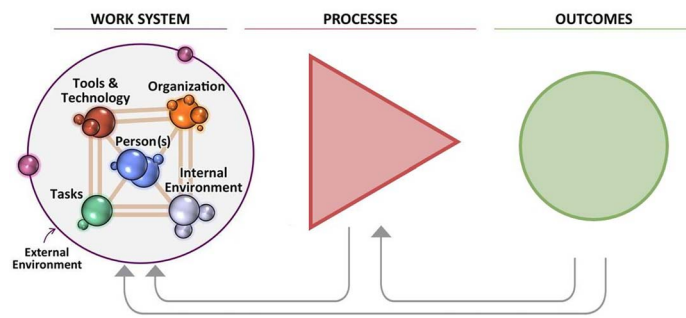
The aim of this article is to highlight the multifactorial importance of embedding HF concepts and methods across a diverse range of initiatives to improve the quality and safety of healthcare.

## KEY PRIORITIES FOR HF SCIENCE IN HEALTHCARE

The HF-based systems approach provides a novel framework for integrating people, technology, physical and social environments, and work systems to safeguard patients and healthcare workers. Thus, the key priorities for an HF-based approach to QI include the design of healthcare facilities, usability of technology, opportunities for learning, and more.

## Systems-Based Approach to Safety

A well-known HF framework for analyzing and redesigning healthcare safety systems is the Systems Engineering Initiative for Patient Safety (SEIPS) (Fig. 1). SEIPS can have significant potential in supporting care organizations and teams in taking a systems-based approach to collective learning from patient safety incidents and complaints



**Figure 1.** The Systems Engineering Initiative for Patient Safety. Reprinted from the National Health Services, UK.<sup>[5]</sup>

as well as successes from routine healthcare. SEIPS can prompt users to identify and explore the interactions that give rise to the incidents.<sup>[2,4-6]</sup> Integration of SEIPS as a multifunctional analytical, design, and improvement tool should be viewed as a priority.<sup>[4]</sup> In addition to SEIPS, a healthcare incident reporting and learning system (HIRLS) can be used to integrate “systems thinking” as a modern approach to safety investigations and team learning. The SEIPS framework can guide the types of initial data to be collected for reportable safety incidents and development of a taxonomy of system-wide contributory factors. HF can help to ensure that a human-centered approach is taken to HIRLS design, including functionality, usability, and learning aspects.<sup>[4,6-8]</sup>

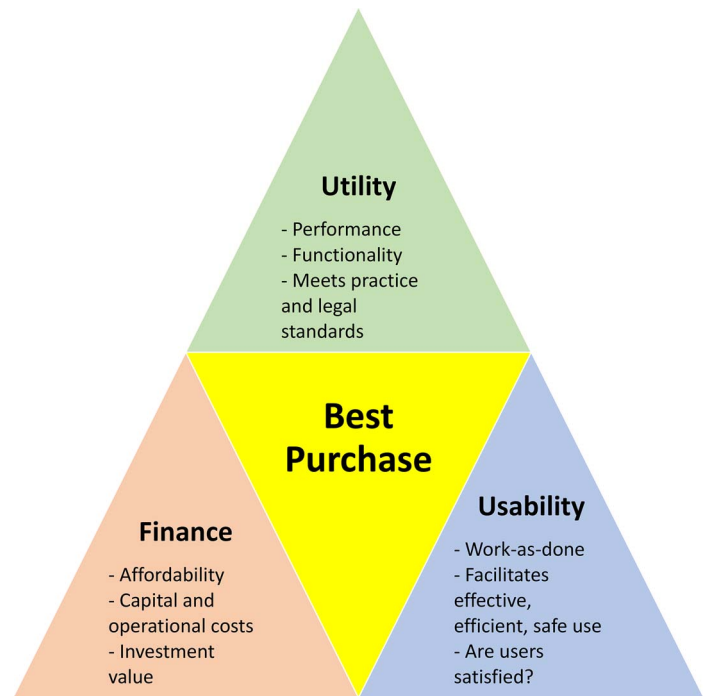
### Human-Centered Design of Healthcare Facilities

It is well-established that the physical healthcare environment can have a significant impact on patient and staff well-being. Although the integration of HF into healthcare building design processes has been encouraged, it is not widely followed, often with significant negative consequences. HF approaches can be applied both prospectively to support the design and planning of new constructions or renovations and retrospectively to gain an understanding of the latent conditions that underpin safety and workplace inefficiency problems.<sup>[6-8]</sup>

### Usability and Safety of Products and Services

Despite the best intentions, all users of suboptimally designed equipment and technologies will, at best, operate inefficiently and, at worst, make errors that can contribute to harm or death. Introducing a usability evaluation as part of the procurement process may decrease the impact of potential risks.<sup>[4,6-8]</sup> Procurement based on finance and utility alone (Fig. 2) may result in maintenance or servicing issues, leading to hidden costs or failed services, and may compromise patient safety and wider quality of care.

Medical devices are essential supports for safe and effective clinical care; however, their effectiveness can be impaired by inadequate design, usability issues, and inadequate implementation. HF input can be incorporated to



**Figure 2.** Ideal procurement model.

facilitate successful design, evaluation, procurement, and implementation of medical devices and address patient safety and usability issues.

Digital technologies, including artificial intelligence (AI)-based applications, are used across healthcare to support care and treatment. Unfortunately, the anticipated benefits are often reduced by inadequate design (i.e., does not support clinical cognitive work) and variability in implementation, resulting in workarounds and lack of uptake. An HF-based understanding of the clinical systems, job tasks, and consequences for performance and well-being is essential to developing good user interfaces and safe, usable designs, and cost-effectiveness.

### Workforce Well-being, Education, and Training

National institutions are beginning to promote a person-centered approach for occupational health and safety of healthcare workforces. This approach aims to create a consistent and effective organizational commitment to the health, safety, and well-being of all staff. HF principles and methods can support and improve risk management in the four priority areas<sup>[2,4,6-8]</sup>: (1) mental health and well-being; (2) musculoskeletal disorders; (3) aggression and violence; and (4) slips, trips, and falls.

In addition, education and training in HF can contribute to improving healthcare system performance and workforce well-being. Currently, there are few examples of accredited HF training in clinical education for medicine, nursing, and allied healthcare professions. The lack of education and training represents an obstacle for HF implementation. Knowledge of HF will remain low

without its integration into educational programs and access to experts in HF science.<sup>[3,8,9]</sup>

## The Leadership Role in Building a Safety Culture

To improve healthcare system performance and staff well-being, there needs to be a focus on the cultural context of work. Organizations with a positive safety culture are more likely to learn openly and effectively from failures and adapt their working practices appropriately. Effective and humble leadership is inextricably linked to the maturity of organizational safety culture.<sup>[10,11]</sup>

Organizational changes, including all workforce and wider system-related changes, have the potential to affect organizational performance and the well-being of people who use and work in the healthcare system. Without proper planning, organizational changes may result in inadvertent lack of emphasis on patient safety management, loss of established formal and informal safety processes, and deterioration of organizational performance. Therefore, the HF implications of organizational changes on health, patient safety, or other relevant outcomes must be considered.<sup>[10,11]</sup>

## RECOMMENDATIONS FOR IMPLEMENTATION

We provide a set of recommendations for key decision makers to strategically integrate HF principles and methods into the healthcare system. The goal is to enhance the quality, safety, and overall performance of the healthcare system.

### Short-Term Recommendations

1. *Awareness Campaign:* Launch a targeted awareness campaign to educate healthcare professionals, policy-makers, and stakeholders about the importance of HF in healthcare.
2. *Training Initiatives:* Implement immediate training programs for healthcare professionals on basic HF principles and their application in daily healthcare practices, focusing on areas like patient safety, usability of medical devices, and incident reporting.
3. *Safety Incident Analysis:* Introduce the use of the SEIPS framework during the patient safety incident analysis, and related systems thinking principles, to identify influential systemic contributory factors and inform system learning, redesigns, and improvement.
4. *Usability Testing:* Conduct usability testing for existing medical devices and digital systems to address immediate safety concerns and improve their effectiveness.
5. *Pilot Projects:* Initiate small-scale pilot projects in select healthcare facilities to demonstrate the immediate benefits of integrating HF into specific aspects, such as patient safety, facility design, and usability of medical devices. Monitor and evaluate the outcomes

and impacts of pilot projects to build on large-scale improvements and sustainability.

### Medium-Term Recommendations

1. *Institutional Integration and Expanded Training Programs:* Integrate HF principles into the curriculum of healthcare education programs to ensure that future healthcare professionals are well-versed in HF concepts. Establish dedicated HF training centers and/or collaborate with existing institutions to provide comprehensive HF training for healthcare professionals. Develop comprehensive and ongoing training programs for healthcare staff, incorporating HF education to create a culture of safety and efficiency.
2. *Specialized HF Roles and Facility Design Integration:* Establish specialized roles for HF experts within healthcare institutions to analyze and improve safety systems, facility design, and the usability of medical devices. Integrate HF specialists into ongoing healthcare facility design projects, ensuring the application of HF principles to enhance safety and efficiency.
3. *Collaboration With Industry:* Foster collaboration between healthcare institutions and industry stakeholders to incorporate HF considerations in the design and procurement of medical devices and technology.
4. *Enhanced Incident Reporting:* Improve the incident reporting and learning systems by incorporating HF analysis, ensuring a deeper understanding of systemic issues contributing to incidents.
5. *Research and Development:* Foster development of innovations to improve the HF aspects of healthcare. Prioritize research in this area and encourage collaboration. Support studies and development of new technologies and solutions that enhance patient safety and workforce well-being through HF principles.

### Long-Term Recommendations

1. *National Policy Integration:* Advocate for the integration and inclusion of HF principles into national healthcare policies, regulations, and standards to ensure a sustained focus and commitment to patient safety, quality, and workforce well-being.
2. *Research and Innovation:* Encourage and support long-term research initiatives to continuously refine and advance HF applications in healthcare, addressing emerging healthcare challenges and technologies, such as the integration of AI, with an HF perspective.
3. *Continuous Improvement:* Establish a continuous improvement framework integrating HF principles to foster a culture of learning and adaptation within healthcare organizations.
4. *Continuous Education:* Implement ongoing education and professional development programs for healthcare professionals to deepen their understanding of HF concepts throughout their careers.

5. *Certification Programs*: Develop certification programs for HF specialists to ensure a standardized level of expertise in applying HF principles within the healthcare context and promoting their inclusion in key decision-making processes.
6. *Global Leadership and Collaboration*: Embed HF science in the international healthcare conferences and invite global experts to contribute to the HF knowledge base. Promote HF science achievements and innovations through global interdisciplinary partnerships between healthcare professionals, architects, engineers, scientists, procurement, digital IT specialists, and HF experts to ensure a holistic approach to healthcare system design.

## CONCLUSION

The integration of HF science into healthcare is imperative for enhancing patient safety, workforce well-being, and overall healthcare system performance optimization. The proposed strategies to increase awareness of HF, integrate an SEIPS framework, and foster research and development in HF science, will contribute to a holistic, sustainable, and impactful transformation that aligns with global best practices and standards in HF science.

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