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Human factors systems approach to healthcare quality and patient safety

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ABSTRACT

Human factors systems approaches are critical for improving healthcare quality and patient safety. The SEIPS (Systems Engineering Initiative for Patient Safety) model of work system and patient safety is a human factors systems approach that has been successfully applied in healthcare research and practice. Several research and practical applications of the SEIPS model are described. Important implications of the SEIPS model for healthcare system and process redesign are highlighted. Principles for redesigning healthcare systems using the SEIPS model are described. Balancing the work system and encouraging the active and adaptive role of workers are key principles for improving healthcare quality and patient safety.

1. Introduction

In the early 1960's Chapanis and Safren[1] (Chapanis and Safrin, 1960; Safren and Chapanis, 1960a,b) conducted one of the first human factors and ergonomics (HFE) studies on medication safety. The researchers used the critical incident technique to examine medication errors. They identified a total of 178 medication administration errors over a period of seven months: (1) wrong patient, (2) wrong dose of medication, (3) extra unordered medication, (4) medication not administered, (5) wrong drug, (6) wrong timing of medication administration, and (7) incorrect medication route. A range of work system factors contributed to medication errors, such as failure to follow required checking procedures, and verbal or written communication problems. This study highlighted the importance of work system issues in medication safety. However, it was not until the publication of the US Institute of Medicine report "To Err is Human: Building a Safer Health System" in 1999 (Kohn et al., 1999) that HFE and its systems approach were recognized as critical for patient safety across all healthcare domains.[2]

Healthcare professionals, leaders and organizations understand the importance of HFE as a scientific discipline that can produce knowledge to redesign healthcare systems and processes and improve patient safety and quality of care (Carayon et al., 2013; Gurses et al., 2012b; Institute of Medicine, 2012; Leape et al., 2002; Pronovost and Goeschel, 2011; Pronovost and Weisfeldt, 2012). For instance, the World Health Organization curriculum on patient safety includes 11 topics, among which two are core to HFE: (a)

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[1] In the published papers on this research, the name of Chapanis' co-author was spelled in two different ways: Safren and Safrin.

[2] An exception is the anesthesia discipline that recognized the value of HFE in the early 1980's and applied HFE tools and methods to the design of monitors and devices as well as simulation as an educational method (Spath, 2000).

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topic 2: What is human factors engineering, and why is it important to patient safety?, and (b) topic 3: Understanding systems and the impact of complexity on patient care (Walton et al., 2010). The US Agency for Healthcare Research and Quality (AHRQ) promotes an HFE approach to the design of health information technology (IT) (NRC Committee on the Role of Human Factors in Home Health Care, 2010, 2011) and has published a variety of guidance documents on using HFE systems models to analyze patient safety events in healthcare delivery (Henriksen et al., 2008, 2009). Various IOM reports have called for the incorporation of HFE, and of systems approaches generally, into health and healthcare research, design, and policy (Grossman et al., 2011; Institute of Medicine, 2001, 2004, 2006, 2012; Reid et al., 2005).

Given the complexity of healthcare (Carayon, 2006), HFE interventions that do not consider issues across the whole system, including organizational factors, are unlikely to have significant, sustainable impact on patient safety and quality of care. For instance, improving the physical design of a medical device or the cognitive interface of health IT is important; but without understanding the organizational context in which these technologies are used, workers may develop work-arounds, the tools may not be used safely, and health IT may be usable but not useful. Therefore, an HFE systems approach to healthcare quality and patient safety should include organizational HFE or macroergonomic considerations.

We have proposed an HFE systems approach to address patient safety and other quality of care problems (see Fig. 1). The SEIPS (Systems Engineering Initiative for Patient Safety) model of work system and patient safety (Carayon et al., 2006b) is based on the macroergonomic work system model developed by Smith and Carayon (Carayon, 2009; Carayon and Smith, 2000; Smith and Carayon-Sainfort, 1989; Smith and Carayon, 2001), and incorporates the Structure-Process-Outcome (SPO) model of healthcare quality (Donabedian, 1978). The SPO model of Donabedian (1978) is the most well-known model of healthcare quality. The integration of the work system model with this prominent model of healthcare quality increases the acceptability of the SEIPS model by the healthcare community. In this paper, we first describe the SEIPS model of work system and patient safety and its research and practical applications. We then emphasize the principle of 'balance' and focus on system interactions that need to be considered in order to make significant progress in healthcare quality and patient safety.

2. SEIPS model of work system and patient safety

Key characteristics of the SEIPS model include: (1) description of the work system and its interacting elements, (2) incorporation of the well-known quality of care model developed by Donabedian (1978), (3) identification of care processes being influenced by the work system and contributing to outcomes, (4) integration of patient outcomes and organizational/employee outcomes, and (5) feedback loops between the processes and outcomes, and the work system (see Fig. 1).

2.1. Work system model of healthcare

Table 1 describes the elements of the work system and provides examples for each element of various work systems. Even if the elements are described separately, it is important to emphasize interactions between the work system elements (see further discussion on system interactions in the section on "Balancing the work system for patient safety"). The SEIPS model is a dynamic model: any change in the work system produces changes in the rest of the work system.

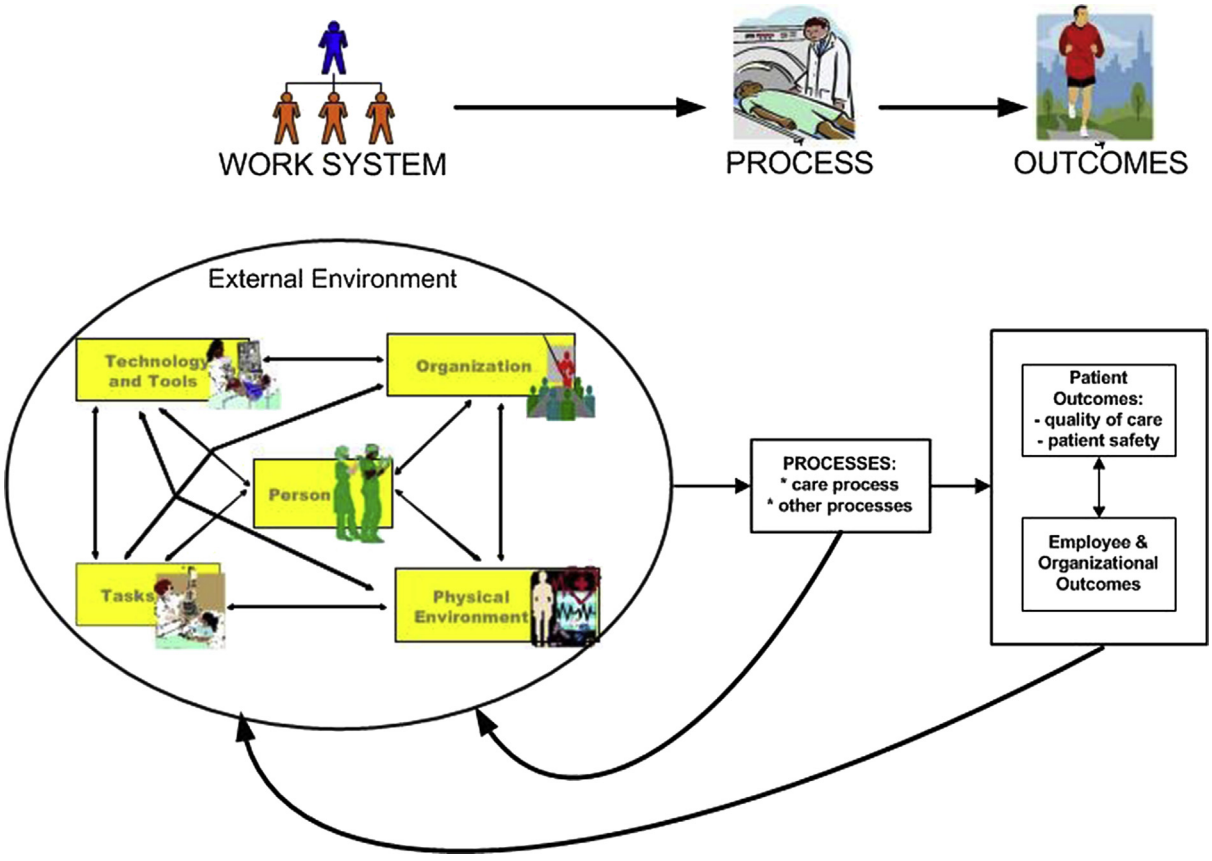

Fig. 1. The SEIPS model of work system and patient safety (Carayon et al., 2006b).