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# TAKING STOCK OF THE SYSTEMS APPROACH TO PATIENT SAFETY

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The application of concepts, theories and methods from systems ergonomics to the domain of patient safety has proved to be an expanding area of research and application in the last 15 years. This paper describes a review of the approach which aimed to identify: the main issues that have been researched; the types of methods of investigation adopted by researchers; the extent to which different system levels are covered; and, the types of medical domain in which work has gone on in the last few years. A total of 360 papers were selected for a detailed review. Approximately 16% of these focused on human error, followed by safety/error frameworks (13%), incident reporting (12%) and perceptions of safety/risk (9%). Most studies have addressed system concerns at the level of the individual (27%). The most frequent methodology used within research adopting the approach are case studies (33%). The findings from the review are discussed within the context of previous evaluations and criticisms of the systems approach and patient safety.

## **Introduction**

The use of systems approach within ergonomics is well established (e.g., Singleton, 1974; Hendrick and Kleiner, 2002) and has been applied to a wide variety of application domains including aviation, rail transport and nuclear power (e.g., Reason, 2001; Wilson et al., 2007). The underlying assumption of the approach is that complex systems, for example organisations, teams and types of technology, are composed of interrelated components, the properties of which are changed if the system is dissembled in any way (Katz and Kahn, 1966). The approach highlights how these components work separately; the degree to which they are coupled together; and their level of complexity (e.g., Perrow, 1984).

Over the course of the last 10-15 years the application of human factors and ergonomics within the domain of patient safety has proved to be a huge growth area in terms of both research and application within healthcare settings. More recently, the use of systems and macroergonomic concepts, theories and approaches has attracted the interest of research groupings drawn from the medical profession (e.g., surgeons, doctors and nurses), medical sociologists and psychologists, as well as ergonomists and human factors engineers. This growth is partly reflected in the growing number of papers and journal special issues covering patient safety that have appeared in recent years (e.g., Bagnara and Tartaglia, 2007; Salas et al., 2006; Edworthy et al., 2006).

Alongside the many calls for the application of the approach to healthcare and patient

safety, a number of criticisms of its use have been made. Infante (2006) for example, states that most empirical work is carried out in the absence of explicit theoretical models and does not adequately address issues relating to the relationship between different levels of analysis and the actors within these (e.g., organisation-team interrelationships). Similarly, Hoff et al. (2004) found that research has so far focused on a limited range of social and organisational factors. Others have argued that the drive toward patient safety and the application of the systems approach may have encouraged the medical profession to seek out short-term solutions (e.g., Wears, 2005), whereas the real benefits of the approach may take decades rather than months or years to realise. These criticisms, alongside the fact that the systems approach to patient safety is a relatively recent phenomenon in comparison to other application domains, motivated the present study. It seems timely and appropriate to take stock of the approach and examine it with reference to current research.

## **Review methodology**

### *Identification of publications*

A search was conducted between September – November 2007 on the PubMed and Ergonomics Abstracts databases for the years 1999-2007 using the keywords “system” and “patient safety”. The year 1999 was taken as a starting point since many researchers regard the publication of the US “To Err is Human” report (Kohn et al., 1999) as a landmark marking the beginning of modern patient safety research. Search operators and wildcards were used in order to ensure that only publications using the terms system (or systems) and patient safety in titles, abstracts or keywords, were retrieved. A total of 4960 publications in total were retrieved (PubMed, n=4875, Ergonomics Abstracts, n=85).

### *Analysis framework*

A set of criteria were used to filter out articles from those retrieved from the databases. These included articles that focused on the following: the use of techniques, procedures or methods that were judged to be primarily medical were not included (e.g., the use of a technique in surgery); the use of a technological system without explicitly referring to it’s use within a safety context; and, case studies which did not specify at least outline details of how, for example, a safety initiative was implemented. The abstract of each article was reviewed and then classified using a modified version of the Vincent et al’s (1998) framework (table 1).

<b>Category</b>	<b>Example Subcomponents</b>
<b>Institutional context</b>	Economic/regulatory, Health system (general), Health system (specific)
<b>Organisational and management</b>	Management/Governance, Local organisational context Communication
<b>Team factors</b>	Leadership, Communication, Handover/Transfer
<b>Individual factors</b>	Knowledge/Skills, Workload/Shiftwork, Work Design
<b>Change management</b>	Implementation of a safety programme
<b>Technology and Design</b>	Design for safety, Patient labelling, System design
<b>Safety and errors</b>	Frameworks, Incident reporting, Errors and Risk perception

Table 1 – Categorisation framework used for the literature review

## Findings

### *Primary focus of studies*

A summary of the results from the analysis concerning the primary focus of publications (top ten categories expressed as percentages of the total number of articles) is given in figure 1. The most frequent focus of studies was “Safety and Errors” (n=202) with the subcomponents “errors” (n=57) being most frequent, followed by “approaches/frameworks” (n=48), “incident reporting” (n=42), “safety/risk perceptions” (n=33) and “safety culture” (n=22). The second most frequently occurring focus of study was the category “individual factors” (n=42) with the subcomponents “training/education” (n=18) being the most frequent, followed by “workload/shiftwork” (n=14) and work design (n=5). Articles within the category “change management” (n=12) focus on describing experiences implementing safety programmes within healthcare (e.g., setting up a quality management initiative).

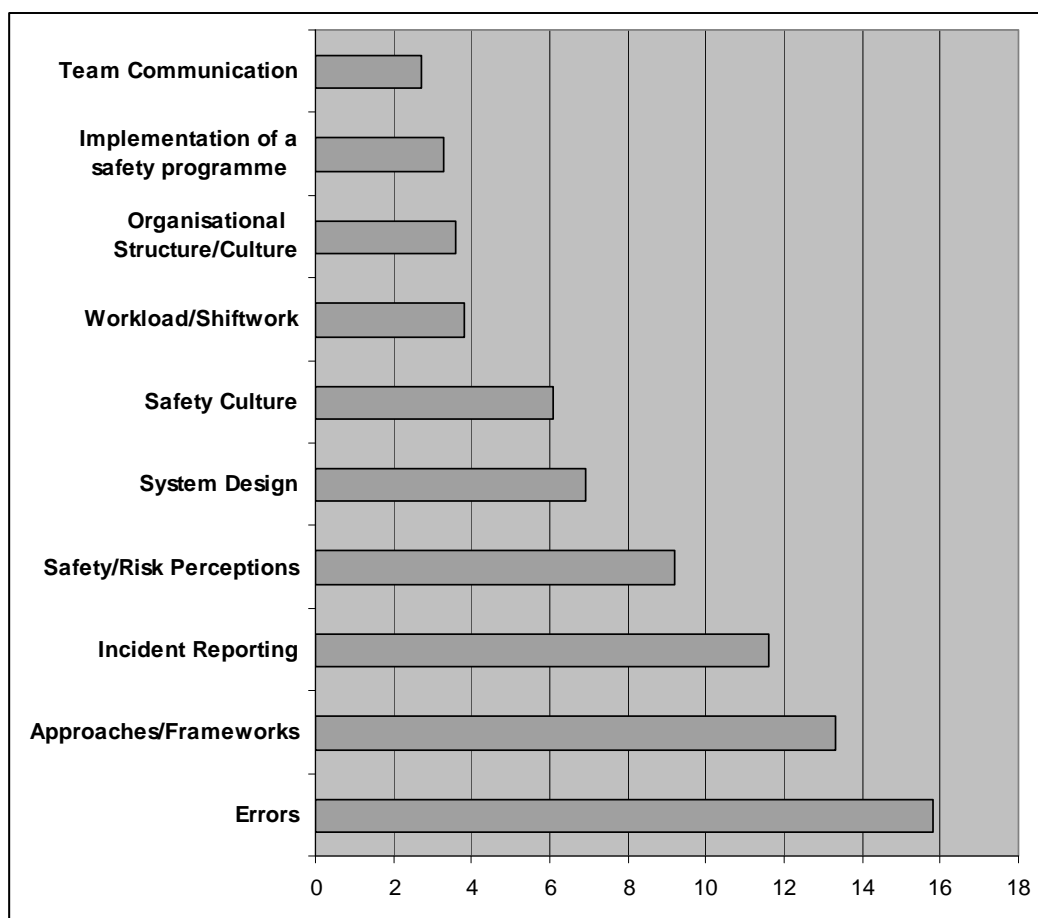


Figure 1: Top ten categories of articles reviewed as percentages of total articles

### *System coverage*

For the majority of articles reviewed it was not possible to identify what levels of the system were covered (n=123 articles). Many articles presented general views on the

relationship between system factors and patient safety (e.g., outlined a safety program or emphasised the importance of incident reporting without providing specific details). Most of the articles that could be identified as relevant to one particular system level concentrated on individuals (n=98). The next highest category were articles referring to the team level of analysis (n=62 articles), followed by the organisational level (n=50 articles). A number of articles mentioned one or more levels of the system (i.e., multi-level, n=22). Few articles mentioned inter-organisational factors that may be involved in terms of the overall system (n=5 articles).

### *Primary methods of investigation*

Most of the articles reviewed employed a case study design in their investigations (n=117). The case studies that were reported tended to be descriptive (n=94), with a smaller amount of articles reporting case studies based upon empirical data (n=23). Approximately a fifth of the articles reviewed used error or incident analysis techniques (n=79). The majority of articles in this category reported on incidents or adverse events that had occurred (n=32), followed by attempts at error analysis/classification (n=28) and articles using Failure Modes Effects Analysis (FMEA) or Root Cause Analysis (RCA) (n=19). Quantitative methods (e.g., questionnaire surveys, checklists) were employed by 47 articles, with fewer articles using qualitative methods (e.g., interviews, observational methods) (n=25).

### *Medical domains*

Approximately half of the articles reviewed were carried out in hospitals and the various medical specialisms which exist within hospitals (n=206, 57.2% of total). Articles which did not focus on a medical specialism (categorised as “general”) made up the majority of these (n=86). In terms of the specialisms a large proportion of the articles were within surgery (n=54), followed by emergency/acute medicine (n=20), pharmacy (n=14), paediatrics (n=11) and intensive care (n=11).

## **Discussion**

In general the results of the literature review provide a rather mixed picture of research that has been carried within the systems approach to patient safety. In many respects the approach is still immature in comparison to other applications in other domains and industries (e.g., nuclear safety). This is reflected, for example, in the lack of coverage of issues which go beyond a focus on errors and incident reporting, as well as the descriptive nature of much of the research carried out so far. A more worrying concern is that research that has used the term “systems approach” has tended to use this term glibly and failed to provide details of the connections that exist between different system levels, as well as the role played by different actors and artefacts, technological or otherwise (Infante, 2006). Chapanis (1996) defines a system as “an interacting combination, at any level of complexity, of people, materials, tools, machines, software, facilities and procedures designed to work together for some common purpose.” At the present time there exist models which seek to combine these elements, but little empirical work that connects the model components together. In other words, there is a need for much more “joined up” research which integrates across disciplinary boundaries and provides a more thorough account of the consequences of adopting the “holistic” possibilities offered by the systems approach. More work needs to be urgently carried out in parallel on theory development and empirical investigation. Much of this could take a direction from other disciplines which have attempted to adopt the systems approach and understand the linkages and causal relationships between organisational levels (e.g., organisational behaviour - House, Rousseau and Thomas-Hunt, 1995).

Finally, the empirical and methodological basis of the approach has as yet not stabilised. Research so far has tended to use the term systems rhetorically and there is a pressing need to go beyond this and to probe deeper not only into the variety of interconnections and linkages that exist within and between system levels, but also the types of behaviour that cut across these levels (e.g., perceptions of individual and team safety culture). Those using the approach need to look again at the roots of systems ergonomics (e.g., systems theory, sociotechnical systems theory), whilst at the same time attempting to learn from past mistakes and difficulties associated with its use that have mentioned in the past (Ashmos and Huber, 1987).

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