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Journal of Biomedical Informatics 38 (2005) 200–212
Journal of Biomedical Informatics
www.elsevier.com/locate/yjbin

Decisions about critical events in device-related scenarios as a function of expertise

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Received 16 October 2004
Available online 9 December 2004

Abstract

This paper presents the perspectives of personnel involved in decision-making about devices in critical care. We use the concept of "sharp and blunt ends" of practice to describe the performance of health care professionals. The "sharp end" is physically and temporally close to the system; the "blunt end" is removed from the system in time and space and yet affects the system through indirect influence on the sharp end. In this study, the sharp end is represented by the clinicians (nurses and doctors) and the blunt end by the administrators and biomedical engineers. These subjects represent the professionals involved in the decision-making process for purchasing biomedical equipment for the hospital. They were asked to "think aloud" while evaluating three error scenarios based on real events. The responses were recorded and transcribed for analysis. The results show differences in interpretation of critical events as a function of professional expertise. The clinicians (sharp-end practitioners) focused on clinical and human aspect of errors while the biomedical engineers focused on device-related errors. The administrators focused on documentation and training. These different interpretations mean that the problems are represented differently by these groups of subjects, and these representations result in variable decisions about devices. These results are discussed within a systems approach framework to help us assess the completeness of the problem representations of the subjects, their awareness of critical events, and how these events would collectively contribute to the occurrence of error.

Keywords: Decision making; Devices; Critical care collaborative decision making; Patient safety; Individual/group expertise; Task analysis; Institutional decision making

1. Introduction

Since the invention of the stethoscope by Rene Laennec in 1816 and the electrocardiogram by Einthoven in 1903, the use of technology in health care has grown by leaps and bounds. However, with the rising costs of health care and the magnitude of device-related medical errors, it is becoming increasingly important to identify guidelines for the purchase of biomedical equipment. There is increased interest in the application of theories and methods from cognitive science in the analysis and modeling of complex human activities [1]. It is only inevitable, therefore, that cognitive science makes its journey should appear in the complex, dynamic world of critical care decision making. The successful application of cognitive science principles to medical decision making, medical education, and medical expertise has spurred its progress, helped by the growing awareness that both theoretical and methodological approaches from cognitive science can contribute to the management of medical errors [1,2]. Medical errors have received recent

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1532-0464/$ - see front matter
doi:10.1016/j.jbi.2004.11.012

attention from academic, healthcare, and governmental institutions following the medical error report from the Institute of Medicine, which named it as the eighth leading cause of death in the US [3]. There are various types of medical errors, including human errors, device-related errors, and errors that can be attributed to the social dynamics of interactions between people and technology in a distributed cognitive system [4]. The distinction between each type is often blurred, as errors are often multidimensional, with factors related to each of the different types of error contributing to its occurrence [5]. Early research into medical device-related errors showed that the errors in the use of equipment were more frequent and had more severe consequences than device malfunctions [6–8]. This in turn paved the way for research into human factors engineering [9–11]. Such research further suggested that even though hospital professionals often allocated blame to the user, the system and the device design are often the most important contributing factors. It also found that blaming the user is not an effective approach and that appropriate user-centered design of medical devices is a more effective means to preventing errors [10–12]. Furthermore, research also suggests that health care professionals' views of error vary based on their training and role in the organization, but this has never been directly studied, leading to this research on the attitudes of healthcare personnel to error [13]. Because the way device-use errors are addressed and reduced in the real world often depends on what the decision makers view as the cause of the error, this paper ventures to look at how a professional's expertise and position in a health care organization affects his or her view of medical errors.

2. Background and theoretical perspective

The paper is based on the premise that decisions made by various personnel involved in the design, development, and ultimately the purchase and use of biomedical devices in any institution influences the outcome and quality of health care provided. Understanding the process by which these personnel make decisions provides a formal way of creating a monitoring system for safety. Reason describes fallible decisions made by designers and high-level managerial decision makers as a basic posit of the framework that he discusses as a general view of accident causation in complex systems [5]:

"This is not a question of allocating blame, but simply a recognition of the fact that even in the best run organizations a significant number of influential decisions will subsequently prove to be mistaken. This is a fact of life. Fallible decisions are an inevitable part of the design and management process. The question is not so much how to prevent them from occurring, as how to ensure that their adverse consequences are speedily detected and recovered".

Some social psychologists describe the fundamental attribution error as the tendency to blame bad outcomes on players' personal inadequacy rather than attributing them to situational factors beyond their control [5,14]. Reason also uses the terms *fundamental surprise* and *situational surprise*, first introduced by Lanir [15]. Fundamental surprise is the profound discrepancy between one's perception of the world and the reality, while situational surprise is a localized event that requires the solution of specific problems. Lanir compares the difference between the two terms to that between "surprise" and "astonishment," illustrating it with an anecdote about the lexicographer Noah Webster. One day, Webster came home to find his wife in the arms of the butler. "You surprised me," says his wife—to which Webster replies, "And you have astonished me." While Webster experienced a fundamental surprise, his wife only experienced a situational surprise. The natural human tendency is to consider fundamental errors as situational ones and respond accordingly—this is called the fundamental surprise error. The recognition of such errors illustrates the importance of seeing the "big picture" during the analysis of errors and to look beyond the mere allocation of blame. An oft-ignored part of error analysis is the recognition of the "world," i.e., the context in which the error occurs.

In this paper, we look at how different personnel perceive factors that contribute to errors that are farther away from the error in space and time than the operator end of the system.

When ascribing blame in an incident to "human error," the implicated individual is at the sharp end of the system [5,16]. In medicine, such individuals could be the clinicians or technicians who are physically or temporally close to the patient. Government regulators, hospital administrators, nursing managers, and insurance companies are at the system's blunt end, having an effect on safety by placing constraints on the practitioners at the sharp end. According to Reason, it is necessary to study the resources and constraints acting on the blunt end to effectively examine how these would eventually affect those who work at the sharp end [5].

Reason also distinguishes between two types of errors: *active errors* (whose effects are felt immediately) and *latent errors* (whose outcomes remain hidden or dormant within the system) [5]. The active errors are generally associated with the sharp end and the latent errors are generally associated with the blunt end. In the purchase of biomedical equipment, for instance, the purchasers, administrators, and the biomedical engineers (the blunt end) act on the suggestions of physicians and the nurses (the sharp end). Keselman et al. [17] de-