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Review Article

Patient Safety and the Significance of Human Factors Engineering Modality: A Review

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Abstract

The issue of patient safety and medical human error has been arousing growing concern around the world. Attempts to reduce the rate of human error present a great challenge, and there is an increased understanding that the issue of patient safety in healthcare systems is a complex one that requires in-depth analysis and understanding. Despite the many programs and interventions designed to reduce the rate of human medical errors, various publications that expose the extent of this phenomenon point to a high percentage of human errors that causes injury, and to the difficulties in improving patient safety. The understanding that the focus must be on prevention and the growing need for practical solutions have led to the involvement of disciplines such as human-factors engineering in an attempt to understand the root causes of safety problems and find ways to prevent them. Human-factors engineering is a proactive approach that may contribute to the planning of safe medical systems by taking into account the diverse needs, capabilities, and limitations of the human beings involved in these systems. This article reviews the benefits and challenges in applying the principles of human-factors engineering to promote patient safety, as well as the implications for policy in the field.

Keywords: Human errors; Patient safety; Human factors engineering; Adverse event

Introduction

In recent decades, the importance of preventing medical errors has become increasingly recognized in healthcare systems around the world. Attempts to reduce the proportion of human medical errors pose a major challenge, and diverse strategies are being developed and applied regularly to improve the quality of health care and medical services. At the same time, it is becoming increasingly clear that the issue of patient safety in healthcare systems is a complex one that requires in-depth analysis and understanding. There is some ambiguity regarding the effectiveness of the various strategies dealing with human medical errors, and about the ability to preserve positive outcomes of interventions over time. The current article reviews the topic of medical human error prevention and specifically the field of knowledge, known as human-factors engineering, which is proving its effectiveness in promoting safety in the medical world in recent years, but is not yet fully integrated into the healthcare system.

Human medical errors in recent decades

Despite the many programs and interventions designed to improve patient safety and reduce the rate of human medical errors committed in many healthcare systems, various publications that expose the extent of this phenomenon do not inspire hope. One of the first and best-known reports to reveal the alarming proportions of human medical error was published by the American Institute of Medicine (IOM) in 1999. This report, entitled "To Err is Human: Building a Safer Health System", presented an assessment based on wide-ranging studies showing that between 44,000 and 98,000 people die in hospitals every year as a result of preventable medical errors [1].

The publication of the report caused a shake-up in the health system, and there were those who even claimed that these numbers were an underestimation of the real situation. This report led the American administration to realize the importance of the subject, and in the years following its publication, to invest considerable efforts to improve patient safety in the health systems. Some 15 years later, two major studies were published examining the changes in patient safety since the publication of the report. In 2015 the UK Health Fund published the report "Continuous Improvement of Patient Safety: The Case for Change in the NHS." The report noted the many challenges that accompany the need for continuous improvement of the health system, including the fact that many health systems are not fundamentally designed to maintain patient safety. The report further stated that patient safety is still undergoing improvement through sporadic local initiatives and individual efforts. The report also described the current situation where most of the resources are invested in reporting and developing indices for health systems that help to learn from the past, but do not help predict the future and prevent errors [2].

At the same time, the National Patient Safety Foundation in the United States published a report entitled "Free from Harm: Accelerating Patient Safety Improvement Fifteen Years after 'To Err Is Human'." Like the UK Health Fund report, this report also noted difficulties in improving patient safety and described the complexity of the phenomenon. In addition, the US report noted the importance of the necessary transition from a reactive approach to a comprehensive proactive and systemic approach that places emphasis on a culture of safety [3]. A recently published study by Makary & Daniel [4], highlighted that the investigators in their study had reported an average of 251,454 deaths per year as a result of human error in the United States. This number was calculated by using findings of previous reports and extrapolating the findings to the total number of hospitalizations in the United States in 2013. To illustrate, the researchers noted that if human error were defined as a disease, it would be ranked as the third leading cause of death in the United States.

Prevention of medical errors

One of the main way to reduce the rate of medical human error is to place greater emphasis on developing prevention strategies, such as promoting an awareness about "almost adverse event (near miss)" and "potential adverse event" [5]. The awareness may be disseminate among the healthcare professionals and the patients via various health campaign medium and policy paper writing.

According to Bogner [6], "Almost adverse event" is an event without adverse consequences or an event that was stopped in time before leading to adverse consequences for the patient. "Potential adverse event" is a situation where there are failures in the environment, which might remain hidden over time and not cause any error, but under certain circumstances, could lead to an irregular occurrence with adverse consequences for the patient. Focusing on and investigating these types of events means transferring attention and resources from handling medical errors after they occur and cause the damage, to putting the emphasis on preventing the various causes of human medical error and handling safety problems before they occur and cause harm to the patient.

Effective coping with safety failures in medicine requires knowledge and skills in various fields such as cognitive psychology, organizational behavior, work research, ergonomics, and more. The understanding that it is essential to focus on prevention and the growing need for practical solutions to medical safety failures has led to the involvement of disciplines such as human-factors engineering in the attempt to understand the root causes of safety problems and seek ways to prevent them.

Human Factors Engineering in Patient Safety

Human-factors engineering offers a proactive approach to promoting patient safety in the healthcare system and puts the emphasis on prevention. This approach provides theories, research methods, and empirical data-based tools to implement interventions aimed at preventing human medical errors and promoting patient safety. Human-factors engineering is defined by the International Association for Ergonomics (IEA) as: "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 optimize human well-being and overall system performance." Iea.cc International Ergonomics Association [7].

In this definition, "system" represents the physical, organizational, and cognitive elements with which humans interact [8]. Human-factors engineering may contribute to the safety planning of medical systems by taking into account the range of needs, capabilities, and limitations of the humans involved in these systems [9]. A system may be a technology, medical device, personnel, team, or organization, procedure, policy, or a physical environment, which must be adapted to human capabilities [8].

More than a decade ago, the Medical Institute and the National Academy of Engineering noted that human-factors engineering is an important tool in planning better health systems [8]. Subsequently, in 2009, a comprehensive report was written for the World Health Organization (WHO), which presented key issues where human and organizational factors may affected the patient safety. The report noted the major importance of understanding the broad range of human factors, such as characteristics of management, of individuals, and of staff, which may affect the behavior of medical team in terms of patient safety. In addition, the report included recommendations for the wider adoption of principles of human-factors engineering to cope with patient safety problems in health systems [10]. The WHO had noted further the importance of human-factors engineering field in patient safety measure. This area shall be included as one of the key academic topics in patient safety programs taught in medical schools [11].

The advantages of applying human-engineering-based methodologies were presented in many studies, from improving work procedures through multi-stage task analysis and identification of potential failures [12] improving communication between medical care provider and patient, and among the medical staff, [13] adapting the physical medical environment to the patient and medical staff [14], improvement of diagnostic and medical decision-making procedures [12,15], to the ergonomic planning and design of medical systems [16] as well as many other subjects.

Challenges in implementing and assimilating human-factors engineering in health system

Despite the international recommendations for employing human engineering principles to improve patient safety, this approach is actually implemented on a limited scale in health systems, and there is a great gap between the real and the ideal. Interventions and applications of the principles of human-factors engineering are carried out mainly through individual, small-scale local initiatives. There are several major challenges that make it difficult to implement human-factors engineering in health systems.

Most of these challenges are generally common to health systems around the world:

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Integrating a culture of safety from a systemic perspective: Human-factors engineering is a systemic approach that does not focus on the search for blame and/or on analyzing cases of medical negligence. Instead, the human-factors engineering approach emphasizes the need to focus on prevention and inculcating a comprehensive culture of safety in the organization. Safety culture means perceptions, which are shared by the health care staff at all level, regarding the importance of various aspects of the work environment such as quality, safety, and service [17]. A culture of safety requires commitment at all level in the organization and an understanding that only a systemic vision - rather than focusing on the individual working in the system - can lead to a wide-ranging improvement in safety. Resistance to change may make it difficult to introduce a safety culture at the overall organizational level. Such resistance is more common in systems where there is greater involvement of the elements related to human behaviour, as in the medical system.

Commitment at the managerial level: As with any change at the organizational level, here, too, responsibility and commitment at the managerial level are necessary. Senior management who is actively engaged in developing a comprehensive patient safety policy, in process management while implementing proactive methodologies such as human-factors engineering, and in promoting interdisciplinary collaboration for comprehensive, in-depth handling of safety issues, will lead to a more active involvement of all medical staff and to a continuous improvement in patient safety. There must be a shift from a reactive policy that deals with human errors after they occur, to a proactive policy that prevents human error before causing serious harm to the patient.

Knowledge of human-factors engineering and its advantages in promoting patient safety: Many studies presented in this article and which appeared in recent years in the literature point to the importance of an in-depth investigation and understanding of human behaviours and human limitations. Understanding the complex characteristics of human errors and of the human factors involved in the medical environment, should be taught as early as in the basic courses of the medical and nursing professions. Specialized teaching programs that investigate human behaviour and its complexity, and discuss the risks and ways of dealing with them to students who, upon completing their studies, will be required to make quick decisions sometimes under conditions of stress and uncertainty [18], can contribute greatly to an advanced and more correct conception of patient safety among medical staff. In addition, workshops and training programs for health care staff at all levels of the organization, where new methodologies and approaches to prevent human error will be studied, can contribute greatly to the continuous incorporation of safety-promoting methods and work processes.

The complexity of the medical system and the difficulty in sustaining improvement in patient safety over time: According to one of the recognized researchers on human error, J. Reason (1990), the medical system is the most complex of all industrial systems [17]. This complexity is reflected in the technologies, procedures, and nature of the work, which is primarily to provide medical care to patients. The outcomes of medical treatment are not always clear and measurable; each patient arrives at the system with different characteristics, and his health and well-being are not always quantifiable. Like many complex systems, the medical system is characterized by workload, competing demands, high risks, time pressure, and very dynamic circumstances. These characteristics make it difficult to consistently implement methodologies to change work processes, procedures, and organizational environment. Due to the very dynamic circumstances, often, even if an intervention based on human engineering principles is successfully implemented, it is difficult to maintain the results of the intervention over time. The complexity of the medical system is unquestionably a major challenge for human-engineering experts [19]. Yet, redesign of medical systems with the diverse elements they contain, based on the principles of human-factors engineering, may contribute to understanding this complexity and help the effort to simplify it.

Implications for Health Policy

As noted, new findings reveal that various medical errors are considered the third most common cause of death in the USA [4]. These and other worrisome findings recently published, highlight the need for a comprehensive policy that must put the emphasis on implementing effective programs to prevent human medical error.

A first step in the healthcare policy requires a change in the priorities of decision makers and policymakers by giving top priority to dealing with human medical errors. Giving top priority would be expressed in actions such as investing resources in prevention rather than in defending error, increasing transparency, holding professional and public discourse on medical human errors, learning from other high-risk systems, and redesigning the medical working environments while taking into account various aspects of safety.

A second step in implementing such a policy requires a shift from investing resources in collecting and analyzing information about failures that have already occurred, together with the information about “near misses” and “potential adverse events”. This kind of shift requires a culture of transparency in the medical environment, encouraging medical teams to report on these events, and maintaining an open discourse as part of their daily work routine. It also requires investment of resources in developing a reporting system that would serve as a database for information related to safety problems, potential risks for human errors, and systemic failures that may lead to human medical errors. A reporting system that would allow medical professionals to report such data without fear from personal repercussions, would enable in-depth study and analysis of various factors, which cause medical human errors, and thus, learning practical lessons to prevent future undesirable events.

Following this, sharing information at the inter-institutional level could also contribute to learning and drawing practical

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conclusions, thus leading to improved patient safety on a large scale. Another step in changing the policy towards preventing human medical errors concerns the education and training of medical staff regarding patient safety issues. Such a step would include studying the subject of patient safety and prevention of medical human errors, in all its various aspects, in the earliest stages of medical and nursing studies. Likewise, training medical staff working in different medical environments to understand, prevent, and deal with factors that may lead to medical human errors, will lead to an increased awareness of the importance of the issue and increase collaboration in the application of proactive methodologies such as human-factors engineering in these environments. These are the first basic steps in transforming the health system from a defensive system that is not safe for neither the patient nor the caregiver, to a proactive system, whose central goal is maintaining the patient's health and safety.

Conclusion

The issue of patient safety and medical human error is arousing growing concern around the world. Despite the development and implementation of many intervention programs in health systems, the phenomenon has not significantly decreased in scale. A thorough understanding of the complexity of the subject, a systemic view, and openness to methodologies taken from other fields, can be helpful in promoting patient safety consistently and continuously. The health system is a complex one with characteristics that distinguish it from other complex systems in industry. At the same time, applying principles of human-factors engineering has proven effective in many studies published in the medical literature. Despite the challenges inherent in implementing changes in the health system based on the principles of human-factors engineering, the medical system must promote this development. Cooperation of this kind could lead to a significant change in the treatment and prevention of medical human errors.

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