Title:
Human Factors Engineering in Healthcare

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Session Title:
Cognitive and System Factors Impacting Nurses' Postoperative Pain Management
Slot:
J 02: Saturday, 29 July 2017: 1:30 PM-2:45 PM
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1:30 PM

Keywords:
cognitive work, health care applications and human factors principles

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Abstract Summary:
Health care work systems are complex, Human factors engineering is a scientific discipline concerned with matching people's capabilities and limitations to design through application of scientific principles and methods. Human factors principles must be considered and used in health care systems around the world.

Learning Activity:

LEARNING OBJECTIVES	EXPANDED CONTENT OUTLINE
The learner will be able to discuss the primary goals of human factors engineering.	Challenges in health care systems Systems perspective Introduction to human factors engineering
The learner will be able to describe application of human factors engineering in health care through example scenarios.	Application of human factors engineering in health care: examples relevance to pain management and cognitive work

Abstract Text:

Health care systems face complex challenges in delivering care and maintaining patient safety. Challenges include improving operational efficiencies, while supporting health care workers' tasks and workflow with appropriate tools, technologies and organizational policies. Patient safety continues to challenge health care teams. Severe, frequent safety incidents are still occurring, and the subsequent economic burden for the hospital continues. Health care professionals work to keep patients safe, while maintaining their work productivity. Safe outcomes not only depend on the health care worker safely delivering patient care but also depend on the underlying organizational environment and culture, the policies affecting their productivity, the physical space where health care operations take place, and organizational support structures enabling patient care work. The tasks designed for health care workers to perform, and the technology provided to support these tasks must reduce errors, decrease cognitive and physical effort and workload, and increase patient safety and productivity. For example, introducing new technology without understanding health care professionals' workflow and functional needs will, in all likelihood, compromise safety, and decrease productivity by forcing health care workers to add new tasks to their already demanding workflow. Similarly, organizational policies must ensure all health care workers have a safe operating environment by designing a balanced staffing load, incorporating training and education, and promoting a safety culture. Addressing health care system challenges requires solutions addressing problems from diverse perspectives, considering people characteristics, both health care workers and patients; technology and tasks characteristics for patient care and health care system operation; an organization's environmental characteristics; and physical space constraints. Most importantly, understanding the complex, and somewhat latent, interactions among all health care elements can help in addressing health care system challenges.

Human factors engineering is directed at studying how humans interact with systems, including their physical environment, technologies and tools they use, tasks they perform, and their organizational setting. According to the International Ergonomics Association, "human factors engineering applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."

Human factors engineering aims to improve safety, enhance performance and increase user satisfaction. It builds on interdisciplinary knowledge encompassing many sub-disciplines such as psychology, cognitive science, management, and computer science. Human factors engineers apply scientific methods to the study and design of human physical and cognitive capabilities and limitations while considering people's organizational and societal settings. The three major sub-domains in human factors

engineering include physical ergonomics, dealing with people's physical capabilities and limitations; cognitive ergonomics, dealing with cognitive processes such as attention and memory; and organizational or macro-ergonomics, dealing with sociotechnical system design.

Health care professionals have applied human factors engineering principles and methods to make health care systems more efficient, effective and safe. Some topics of research have been examining errors, technology and usability, teamwork and organizational culture, physical environment design, diagnostic decision-making, anthropometry and lifting, and workload.

As an example, consider a nurse's workflow when providing patient care. A nurse may care for several patients during a shift; the patients present different complexities, and consequently different needs for care, requiring the nurse to engage in teamwork with other health care professionals to provide the most effective care. Patients, when located in separate geographical spaces, may require the nurse to plan and coordinate patient visits. Any coordination not only requires physical effort but also requires cognitive planning to meet patient needs in a timely manner. Nurses engage in patient care and secondary tasks throughout the day, sometimes amidst interruptions and distractions. Reducing nurse' workload necessitates carefully considering a care facility's physical design and layout. Additionally, the criteria used to make patient assignment decisions needs to consider the number, case complexity and unique patient needs for patients assigned to a specific nurse, and the geographical separation between different patients.

Nurses' workflow requires significant interaction with health information technologies to document the care provided. The technology should support nurses' tasks and routine workflow and facilitate planning, problem solving and decision-making activities, so the nurse can focus on providing effective care. Nurses play an important role in many care processes including admission, handoff communication to transition patients, medication administration, routine monitoring and care, ambulation, documentation, patient and family education, and discharge. The tools and technologies provided and organizational policies should help nurses seamlessly coordinate between different but connected care processes.

The significant amount of coordination, documentation and managing patients is heightened when nurses need to perform pain management. Pain affects each patient in a different way, demanding customized care from nurses. This requires nurses to perform significant cognitive work in planning and individualizing care for each patient with pain, accounting for clinical and individual characteristics, tolerance for pain, and evidence-based guidelines on pain management. The most challenging aspect of cognitive work in pain management involves constant prioritization of tasks between pain management and non-pain management patients. Additionally, a patient's condition may change quickly, requiring constant monitoring and timely responses from nurses. Changes in a patient's condition will require re-prioritizing workflow, so the nurse can effectively manage emerging problems. An informal intervention that is already successful for pain management from the nurses' perspective is the coordination and teamwork among nurses to provide peer support in managing complex health care tasks. If the same type of support can be enhanced among the interprofessional team, demands from cognitive work involved in pain management will be greatly reduced, and pain management processes will be effective from the patient's perspective. For example, the team surrounding a patient experiencing pain would involve not only the immediate care team of nurses and physicians but may involve physical therapy, pharmacy, pre-operative care, labs, and procedures. Interprofessional coordination among these entities is crucial for effective pain management. However, nurses often undertake the responsibility to coordinate among these different entities for effective pain management, further increasing their cognitive work. Managing uncertainties and dynamic changes impact nurses' workflow and requires significant cognitive work. On a typical day, nurses may perform cognitive work involving planning, prioritization, coordination, problem solving, and decision-making. Understanding nurses' cognitive work involved in caring for a patient and designing support systems to facilitate their cognitive work will ensure a safe and productive system.

In summary, knowledge on how best to implement and use evidence-based practices for pain is still lacking. Additionally, we do not know what cognitive work components are involved in pain management, how nurses engage in cognitive work for providing pain management, and how best to intervene to

improve the pain management process. A nurse's workflow requires functioning within health care system constraints and encompasses other health care workers, tools and technologies, tasks, and organizational policies within a physical space. Systematically designing the work system from a human factors engineering perspective with consideration to cognitive and physical work elements can help generate design solutions to support nurses' work. When developing design solutions, designers must consider the interactions between different health care elements so the underlying system characteristics improve. Our study on cognitive work in pain management provides a case example to investigate cognitive work in pain management from a systems perspective.