Designing CPOE Systems Using an Ecological Approach
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Abstract
Medical ordering is a complex socio-technical system that contains many collaborative actors. We propose using the Cognitive Work Analysis framework to identify work environment constraints and develop software requirements for order entry systems. Our goal is to understand how to design ordering systems that support workers and help them make decisions and adapt to new situations safely and effectively.

Background and Motivation
Decision support systems are a component of computer practitioner order entry (CPOE) systems designed to prevent medical errors and increase system safety. We previously reported on a study of override rates in the Veterans Affairs’ Computer Patient Record System, an example of a CPOE system. We showed that override rates of critical drug-drug and drug-allergy alerts have remained high over time. (1) This suggests that decision support systems can be improved.

One method for creating safer CPOE systems is to increase the sensitivity and specificity of alert systems. In contrast, we propose an alternative approach using a constraint-based, ecological approach to software design that supports complex, socio-technical work environments. We believe this design approach will also improve CPOE system safety.

Cognitive Work Analysis
Our methods draw heavily from Cognitive Work Analysis (CWA), a framework developed from ecological psychology and cognitive engineering that focuses on the evaluation of work rather than tasks. (2) CWA is specifically suitable for complex socio-technical environments, such as medical ordering where workers must respond to unpredictable and variable events. Such systems are considered “open,” and the tasks needed to accomplish work are less able to be explicitly predefined. (2) Software designed for open systems needs to account for variation and permit workers to make decisions and adapt to new situations safely and effectively rather than conform to a specific set of instructions. To support this, the CWA framework sets out to identify environmental constraints that influence behavior.

The task of ordering takes place within a larger complex, socio-technical system of hospitals and healthcare. This system contains many different clinicians, non-clinical staff and patients who collaborate to make decisions and perform tasks. These actors must adapt to situations with incomplete and uncertain clinical or patient data. Furthermore, they must also contend with unanticipated events. We believe these characteristics suggest that a constraint-based approach to work analysis such as CWA is appropriate for modeling the work environment.

Implications for Design
Using the CWA framework will allow us to create software requirements based on a constraint-based and ecological approach to work analysis. Other approaches have focused on designing towards specific tasks and instruction sets or worker mental models, but in complex systems, these mental models may be incomplete, inaccurate or unaware of the larger environment.

However, we intend to go beyond CWA and would like more than a set of software requirements. Thus, we plan to develop or extend methodologies that can use the requirements that result from CWA analysis to drive pragmatic design implications and real working prototypes and systems.

Research Plan
Our research plan is to apply the CWA framework in a qualitative study of an inpatient hospital ordering environment and develop CPOE software requirements. We will then develop a methodology to translate those requirements into a design specification and prototype. Our goal is to demonstrate a software development lifecycle that begins with CWA principles.

References