Mobile Technologies and Patient Care: A Cognitive Systems Engineering View

Penelope SANDERSON

Schools of Psychology and of Information Technology and Electrical Engineering, The University of Queensland, St Lucia, Queensland Australia

Keywords. Mobile technologies, advanced technologies, patient monitoring, cognitive systems engineering

1. Overview

Mobile technologies such as smartphones and tablets have had a dramatic effect on how information relevant for a patient's care can arrive at the actual point of care in hospitals or other clinical contexts. More recently, lightweight wearable technologies have started to emerge that make it possible for information to follow clinicians with hitherto unimagined ease, and for interaction to take place in a hands-free manner. Developers are exploring the potential for video glasses and other tools to create a rich, mobile, information environment for clinicians and other healthcare providers. However, what are some of the challenges involved in realizing such a vision? Will all of the consequences be desirable? How will we know?

In this presentation I will discuss the cognitive and organizational challenges posed by advanced wearable technologies for monitoring the well-being of patients in hospitals and other clinical contexts. I will outline some of the technologies that are emerging. Then I will highlight cognitive systems engineering frameworks that may guide thinking about the consequences—intended, unintended, positive, and negative—of introducing such technologies into practice.

2. Technologies

Smartphones and tablets have been in healthcare contexts for many years now, yet in some jurisdictions there are profound concerns about their use. Given the increasingly porous distinction between personal technologies and professionally useful applications, concerns emerge about how to guide clinicians in appropriate personal use vs. professional use. Moreover, the potential for cross-infection becomes a major concern.

The emerging generation of video glasses such as Google Glass™ and the Vuzix M100™ provide access to the kind of information previously on smartphones and tablets, but in a smaller and more portable form factor. Previous research on head-worn technologies has indicated where their advantages lie—the hands can be free, commands can be voice or even eye-activated, and information can be displayed continuously in the forward field of view, regardless of the wearer's location or orientation. However, there are also areas of concern. For example, there is some evidence that even though information is displayed in the forward field of view, wearers may not be as aware of certain kinds of changes as they would be if turning to view a conventional monitor; the wearer may be overconfident that they are assimilating all the information displayed. In addition, the interruptive nature of some possible applications for video glasses could disrupt workflow and make the resumption of an interrupted task more difficult.

Auditory and tactile displays have a role to play alongside video glasses as wearable technologies, potentially integrated with them. Both the former offer eyes-free monitoring, relieving the often-overloaded visual system of some demands, but at the cost of how much detail can be conveyed. However the hospital context already suffers from high levels of noise, often from conventional auditory alarm systems. High levels of noise can fatigue patients and slow their recovery. As a result, auditory displays probably have better potential as personal display systems, delivered via Bluetooth™ earpieces, or even via the earpieces of video glasses. Auditory displays can direct the wearer's attention to information that might be getting overlooked, so helping to correct for shortcomings in head-worn displays.

Tactile displays have recently also been explored, and are inherently personal display systems, by the very nature of the tactile sense. In noisy, visually demanding environments they offer a further way to remind, notify, or alert a user. However tactile displays pose problems in relation to when they should be worn, and where, and how easily they can be put on and taken off.

3. Determining consequences

Predicting the impact of new technologies, or novel forms of information delivery such as those outlined above is often desirable, but seldom done systematically. All the above technologies have been developed and (where relevant) fielded with the goal of promoting the intended positive consequences and circumventing current bottlenecks, delays, coordination problems, and so on. In many cases, unintended positive consequences are discovered. Clearly, though, there will be concern about unintended negative consequences. How can decision makers gain some level of confidence that advanced wearable technologies can be introduced into healthcare contexts safely and appropriately?

Cognitive systems engineering provides an array of conceptual tools that can be adapted to help analysts reason through possible consequences. Some of those tools have originated in the cognitive systems engineering work of Jens Rasmussen and his colleagues. The past, present, and potential future use of those tools to help analysts think through the possible consequences of new technologies will be outlined in this talk.

The "Legacy of Jens Rasmussen" Symposium, an Adjunct Symposium to the ODAM conference, is a further context in which the ideas of Jens Rasmussen and colleagues will be discussed, focusing in particular on the influence of Rasmussen's ideas on current research and practice in the modeling, analysis, design, and evaluation of complex safety-critical sociotechnical systems.