Developing hybrid macroergonomic methodologies: a systems foundation for consumer health IT design
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1. Introduction
As the locus of care shifts from institutional to home and community-based settings (Bureau of Labor Statistics, 2010; National Association for Homecare and Hospice, 2010), patients are increasingly responsible for managing their own health and health information (Or & Karsh, 2009). Consumer health information technology (IT) solutions, such as personal health records, decision support systems, and self-management systems, are being developed to support patients (Jimison et al., 2008).

Given the nature of activities patients engage in to support self-care and self-management, these responsibilities may be regarded as a form of work. Consequently, macroergonomic methods may be extended to this domain. From a macroergonomic perspective, all work system elements should be aligned to increase performance and well-being (Dul et al., 2012). This alignment is achieved by jointly optimizing components of both the social and technical subsystems. However, in the case of self-care and self-management, some work system elements may not be amenable to design or redesign (i.e., physical and social aspects of the home and community). Instead, technologies such as consumer health IT must account for existing work system elements’ constraints.

2. Practice Innovation
Recognition of self-care and self-management as work conducted by patients in home and community environments has led to a recognized need for using a macroergonomics approach to understanding user requirements for consumer health IT (Holden, Schubert, & Mickelson, 2015; Valdez, Holden, Novak, & Veinot, 2015; Zayas-Cabán, 2012). Such an approach recognizes the need to attend to patients, their family members, activities, and context within the design process. This paper reviews existing macroergonomic methods and their appropriateness for systems analysis of patient work activities and contexts and for informing the design of consumer health IT. We propose new hybrid methodologies for consumer health IT design that combine a macroergonomic framework with existing methodologies outside the field of human factors/ergonomics (i.e., manufacturing, sociology).

3. Sources of Information
A literature review was conducted to identify and evaluate existing macroergonomic methods that have been used in consumer health IT design or applied in other domains. Our analysis identified the need for methodologies that can inform design of consumer health IT while simultaneously accounting for the larger work systems in which patients are embedded. To this end, we developed two “hybrid” macroergonomic methodologies that may be used to conduct needs assessment as part of consumer health IT design. These methodologies combine a detailed understanding of a specific dimension of health information management with a systems understanding of how that dimension aligns with other work system elements.

4. Findings
The review identified multiple macroergonomic methods that have either been used to inform the design or redesign of consumer health IT or that have been applied to other domains and may be useful in understanding health information management (Haro & Kleiner, 2008; Holden et al., 2015; Karsh & Alper, 2004; Marquard & Zayas-Cabán, 2012; Moen & Brennan, 2005). Strengths and weakness of these approaches as relevant to consumer health IT design included the degree to which methodologies were efficient, intrusive for participants, replicable, grounded in a systems perspective, enabled focused assessment of a portion of the design space, participatory, and yielded rich data. Two hybrid
macroergonomic methodologies were developed which build upon the strength of previous methods in relation to these characteristics. The first methodology, *health information maps*, combines a macroergonomic framework with a facilities layout approach, enabling the designer to systematically capture information about the distribution of health information within the home while conducting a systematic exploration of how this distribution interacts with health information management practices. The second methodology, *social networks of health information communication*, combines a macroergonomic framework with social network analysis, enabling the designer to systematically capture information about whom patients communicate health information, while conducting a systematic exploration of what, why, and how health information is communicated with these individuals. While both methodologies yielded design requirements for all dimensions of consumer health IT (Valdez, Gibbons, Siegel, Kukafka, & Brennan, 2012), the first methodology yielded deep insight into functionality required to support health information storage and retrieval and the second into the functionality required to support health information communication with social network members.

5. Discussion

The development of the health information maps and the social networks of health information communication methodologies demonstrate the feasibility of creating hybrid macroergonomic approaches. Such methodologies represent a starting point for integrating macroergonomic perspectives into investigations of more focused design problems. In doing so, these methodologies have the potential to increase efficiency and decrease intrusiveness for users while remaining participatory and relying on a systems perspective. While the methodologies described in this paper are specific to the domain of consumer health IT, other hybrid macroergonomic approaches may be relevant to other consumer product domains, such as entertainment, communication, and finance.

References
