
Challenges in Evaluating Three Assistive Health Applications

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Abstract

In this paper we describe three assistive health applications we have had experience designing and evaluating. The evaluations took place in various environments – including a dialysis unit, home, and community center. We learned that we must be mindful of rules, culture, comfort, and time when conducting studies to evaluate assistive health applications.

Keywords

Health Informatics, Personal Health Records (PHRs), Assistive Technologies

ACM Classification Keywords

H.5.2 [User Interface]: Evaluating/Methodology

Introduction

The Wellness Innovation and Interaction (WII) Lab designs, implements, and evaluates mobile applications that can improve a population's health and wellness. Our research motivations are two fold - we want to provide people with easier solutions to improve their health and wellness while assisting researchers in other disciplines study new, technical interventions. We address our first motivation with a user-centered design approach where we use ethnographic methods (e.g., interviews and observations) and more traditional human-computer interaction (HCI) methods (e.g., cognitive walkthrough, usability studies, experience

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sampling) to arrive at a holistic view of how our user population may or may not incorporate technology into their lives. We address our second motivation by collaborating with researchers in medical and social science disciplines to assess the needs of a specific population, showing how technology can possibly help, and studying best practices for interdisciplinary and transdisciplinary research.

Experience and Approaches

In this paper, we discuss three health and wellness related projects that we have worked on and the approaches used for evaluation.

DIMA

The Dietary Intake Monitoring Application (DIMA) is a NIH-funded R21 project first conceptualized by a nurse researcher and health informatics professor to help an inner-city, low-literacy population with Chronic Kidney Disease (CKD) monitor and manage their diet. Patients with CKD have lost most, if not all, kidney function, requiring them to undergo dialysis three times per week to remove fluid and toxins from their blood. If patients do not strictly adhere to dietary limits (e.g., sodium and potassium) they can have life-threatening complications [1, 13]. Unfortunately, many patients lack the cognitive processes (literacy, memory and/or computational skills) to monitor their diet [9, 10]. The DIMA project uses mobile technology (i.e., a Personal Digital Assistant - PDA) to assist patients in computing their nutrient consumption and provide feedback about how their consumption relates to prescribed diets [12].

The first author was involved in designing and conducting initial user studies to inform DIMA's interface [14] and feasibility of functionality [15]. She

found that because of time constraints of the target population, studies had to be conducted in a dialysis unit during treatment. The environment and participant abilities prompted her to develop new ways to conduct paper prototyping and high fidelity training and testing in hospital environments [11].

Colorado Care Tablet

The Colorado Care Tablet (CCT) is a Robert Wood Johnson Foundation funded project led by a research clinician specializing in medical informatics and chronic disease management. CCT is a Personal Health Record (PHR) Tablet PC application that helps older adults, during transitions of care, coordinate their care among multiple providers and caregivers, and learn about the medication they are consuming. Medication errors are prevalent among older adults who are in transition between the hospital, home, or assisted living community [6]. CCT empowers older adults to learn about about medications and updates caregivers and medical professionals about the medications they take. This intervention was informed by the highly successful paper-based transition of care PHR designed by Eric Coleman [4].

The first author was involved in designing user studies and training researchers to conduct user studies for the duration of the project. For six months, the CCT team conducted a needs analysis and learned about medication issues older adults experience. In this time, we conducted thirteen in home contextual interviews with twenty participants (an older adult with occasionally a caregiver) and four focus groups (two exploratory and two confirmatory) with a total of fifteen participants. Once needs were established, we iteratively prototyped CCT with low fidelity and high

fidelity prototypes during six modified Rapid Iterative Testing and Evaluation (RITE) sessions [5]. During RITE sessions, we met individually with three to four individuals for an hour each.

Health Bridge

Health Bridge is a new project that the first author is working on to assist low-income, single parent caregivers plan, coordinate via social networking, create, and monitor nutritional meals for their family. Health Bridge addresses the needs of caregivers by aggressively tracking all facets of family nutrition from shelf to table to PHR. Health Bridge interfaces with and enhances PHRs by providing caregivers with a bridge to access and update their PHRs with additional data health professionals need for personalized nutritional health feedback. A recent study showed that almost 90% of preschoolers in the population we work with are exposed to at least one *modifiable chronic disease risk factor* - such as obesity and high blood pressure [3]. Since caregivers are the “gatekeepers” to family and community health [2], our focus is in designing the intervention for primary caregivers of young children.

Our research is inspired by community based participatory research (CBPR) that demands that research topics are community concerns [7]. Our preliminary work with seventeen single parent caregivers established that nutrition is important, but they experience many barriers to making healthy behavioral change (e.g., family illness, understanding information, wasting food, and affording food) [8]. We verified our interview findings by conducting design workshops with four caregivers and six children. There are many challenges with conducting workshops with entire families and break-out activities with adults and

children that we can discuss at the workshop. Our commitment to CBPR is reflected in the design of Health Bridge in that it empowers, rather than lectures, the community.

Challenges

Here we briefly outline some of the evaluation challenges we have encountered in the three projects.

1. Understanding Rules, Regulations, and Culture of the Environment – For DIMA, we could not use recording equipment in the dialysis unit, thus we had to use shorthand or cheat sheets for recording evaluations. For Health Bridge, we connected with a trusted community outreach group to recruit caregivers, but did not understand the incredibly complicated work schedules of single caregivers and had to meet at unorthodox times to accommodate schedules.

2. Being Mindful of the Environment and Participants' Comfort – For DIMA, we had to laminate paper prototypes for easier disinfection. In addition, we had to use earphones when playing back voice recordings so that inadvertent recordings of personal conversations were not disclosed to everyone in the unit. For Colorado Care Tablet, we had to be mindful of the medications we saw and pose questions appropriately. For example, a man who takes Viagra may not want his partner and probably his caregiver to know he takes the medication (this is also a complication when designing medication list managers).

3. Adapting to Interruptions – For DIMA, we modularized tasks in our study so that if a participant needed medical attention during the study (and treatment), we could pause the study and recruit

participants in the unit for the next time slot. For Health Bridge, we had to deal with sibling arguments and associated caregiver intervention. Thus, schedules had to have miscellaneous time built in and all activities had to have the option to be done alone.

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References

- [1]R. Agarwal et al., "Prevalence, treatment, and control of hypertension in chronic hemodialysis patients in the united states," *Amer. J. of Medicine*, 115, 2003, pp. 291-297.
- [2]I. Anderson et al., "Shakra: Tracking and Sharing Daily Activity Levels with Unaugmented Mobile Phones," *Mobile Networks and App.s*, 12, 2007, pp. 199-185.
- [3]A. J. Barton et al., "Cardiovascular risk in Hispanic and non-Hispanic preschoolers," *Nursing Research*, 55, 2006, pp. 179-172.
- [4]E. A. Coleman et al., "Preparing patients and caregivers to participate in care delivered across settings: the Care Transitions Intervention," *J.Am.Geriatr.Soc.*, 52, 2004, pp. 1817-1825.
- [5]W. Dennis, "Evaluating usability methods: why the current literature fails the practitioner," *interactions*, 10, 2003, ACM, pp. 28-34.

- [6]J. H. Gurwitz et al., "Incidence and preventability of adverse drug events among older persons in the ambulatory setting," *JAMA*, 289, 2003, pp. 1107-1116.
- [7]B. Israel et al., "REVIEW OF COMMUNITY-BASED RESEARCH: Assessing Partnership Approaches to Improve Public Health," *Annual Review of Public Health*, 19, 1998, pp. 202-173.
- [8]J. Maitland, K. A. Siek, & M. Chalmers, "Persuasion not Required: Obstacles Faced by Low-Income Caregivers to Improve Dietary Behaviour," In Review.
- [9]J. L. Welch, "Fluid management beliefs by stage of fluid adherence," *Research in Nursing and Health*, 24, 2001, pp. 105-112.
- [10]J. L. Welch, "Differences in perceptions by stage of fluid adherence," *J. Renal Nutr.*, 13, 2003, pp.275-281.
- [11]K. A. Siek, and K. H. Connelly, "Lessons Learned Conducting User Studies in a Dialysis Ward," *Reality Testing: HCI Challenges in Non-Traditional Environments Workshop*, 2006.
- [12]K. H. Connelly et al., "Mobile Applications that Empower People to Monitor their Personal Health," *e&i Elektrotechnik und Informationstechnik*, 123, 2006, Springer Wien, pp. 124-128.
- [13]A. Sacchetti et al., "Emergency department presentation of renal dialysis patients: Indications for EMS transport directly to dialysis centers," *Journal of Emergency Medicine*, 9, 1991, pp. 141-144.
- [14]K. Siek, K. Connelly, and Y. Rogers, "Pride and prejudice: learning how chronically ill people think about food," *CHI '06: Proceedings of the SIGCHI conference on Human Factors in computing systems*, New York, NY, USA, 2006, ACM, pp. 950-947.
- [15]K. Siek et al., "When Do We Eat? An Evaluation of Food Items Input into an Electronic Food Monitoring Application," *Pervasive Health Conference and Workshops, 2006*, 2006, pp. 10-11.