TOWARD PATIENT-CENTERED, STANDARDIZED, AND REPRODUCIBLE APPROACHES OF EVALUATING THE USABILITY OF MHEALTH CHRONIC DISEASE SELF-MANAGEMENT SYSTEMS FOR DIABETES

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Abstract
Diabetes is a chronic disease affecting 422 million patients worldwide according to World Health Organization data with 30.3 million in the United States and 64 million in Europe. The prevalence speaks to the need for improved ways to support patients in disease self-management. mHealth solutions are increasingly used for this; however, usability is a current challenge affecting patients’ mHealth use. Recent literature emphasizes an increased focus on patient-centeredness in diabetes care, user-centeredness in chronic disease mHealth system design and standardized, systematic approaches for usability evaluation. The aim of this thesis and its individual studies was to incorporate these foci into the evaluation of two mobile health self-management systems for diabetes.

Study I used ISO standard 9241-11 to examine the relationship between selected group characteristics of diabetes patients on specific interaction outcomes to quantitatively identify needed system modifications. Study II utilized a multi-method design to assess diabetes patients’ mHealth usage and combined two novel analytic methods to structure and analyze results. Study III used a modified, user-oriented heuristic evaluation (HE) method, validated tasks and in-depth severity factor ratings to identify critical problems from patients’ point of view. By developing and employing a modified, user-centered cognitive walkthrough method (UC-CW), study IV assessed its effectiveness and efficiency in finding relevant usability problems for users as well as patients’ acceptance. The modified CW was validated against the golden-standard user test with Think Aloud.

Study I emphasized the importance of considering user characteristics in mHealth performance as these influenced interaction outcomes. All patients had difficulties with multiple-step tasks. Patients more recently diagnosed were able to perform tasks more successfully, with fewer errors and at faster times and had higher satisfaction scores; similar outcomes to the more experienced users. Educational level did not, however, seem to influence performance. In study II, the usability test with Think-Aloud (TA), in-depth interviews and questionnaires contributed to 19 consolidated issues, and triangulated on 5 critical usability problems for users. The combined analysis methods resulted in structured, categorized descriptions to aid in problem-solving. In Study III, the disease-related, critical information deficiencies found by expert evaluators using the modified, structured method also converged on and highlighted potentially adverse user concerns. Study IV demonstrated that the UC-CW found more critical user problems compared to the user test with TA despite both methods producing similar major average severity ratings and violations of heuristic categories. The modified method was more efficient per detected problem and experienced as less cognitively demanding and with a higher ease of use.

These studies offer different approaches that include patient-centered, efficient and user-acceptable methods and method modifications to detect critical usability issues for users. Importantly, improved mHealth designs for users could mean improvement in interactions, interaction performance, increased adoption, and long-term perhaps even increased adherence to interventions for chronic conditions.

**Keywords:** Chronic Disease, Diabetes, Mobile Health, mHealth, Self-management, Usability Evaluation, User-centered Design