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A Usability Evaluation of the InfoSAGE App for Family-Based Medication Management

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Abstract. The design of a mobile medication manager within a broader family and elder-centric collaboration platform faces challenges of usability and wide applicability. To inform the development and use cases of eldercare apps, we present the preliminary results of a usability study of an iOS and Android app intended for both family members and aging adults for the mobile management of medication lists. Seven participants were recorded during the performance of eight typical use-case scenarios of the medication portion of the InfoSAGE app. Audio and video recordings were analyzed for themes and events. The aim of this paper is to help inform future design choices for eldercare mobile apps.

Keywords. health information technology (HIT), elderly, smartphone, usability

1. Introduction

There is a rising life expectancy of populations in both developed and developing countries. The number of people aged 60 years and over has tripled since 1950 and is projected to reach 2.1 billion by 2050 [1]. Many informal caregivers of frail elders have high levels of stress that can lead to physical, mental and financial problems [2]. Technology enabled support systems may help improve the care coordination between patient and family members [3-4] but acceptance of technology and sustained usage for elder care application remains a challenge [5-11], particularly for mobile applications [5,6,11]. We present the preliminary results of a usability evaluation of the InfoSAGE [3] family-based care coordination mobile app, and propose recommendations for the development of future mobile applications for medication management for elders.

2. InfoSAGE

InfoSAGE (https://www.infosagehealth.org) is a communication and collaboration platform for family caregivers and elders navigating the aging process developed by the

Division of Clinical Informatics at the Harvard Medical Faculty Physicians at Beth Israel Deaconess Medical Center (BIDMC) in conjunction with aging researchers at the Institute for Aging Research at Hebrew Senior Life [3]. It consists of a web-app and mobile-app for the sharing of tasks, calendars, contacts, medication lists, and associated care discussions. InfoSAGE is primarily intended as a family-centric tool coordinating care around a single elder, called a keystone, but is frequently utilized by single users for the management of medication lists. InfoSAGE is open to the public and free to use. To date, 321 users have signed up across 180 family networks.

Currently, the primary focus of the research surrounding the InfoSAGE platform is in the observation of changing medication lists, the discrepancies between family maintained lists and medications recorded in health records, and medication safety. A novel, family-curated medication manager was developed for InfoSAGE, leveraging online National Library of Medicine databases, and versatile recording methods to capture name, type, dose, strength, route, indication, schedules, and administration directions in a readily accessible and shareable format. Owing to the diversity of age within our target user population, InfoSAGE was developed to be approachable and usable by both aging older adults, their baby-boomer children, and younger users. Despite increasing smartphone use in those 75 or older, achieving the desired usability across this age range can be challenging and benefits from iterative, systematic design.

3. Methods

A convenience sample of subjects was recruited from the Boston area using advertisements and referrals from collaborating facilities at Hebrew Senior Life, and through a grass-roots campaign focused on BIDMC. Online local message boards were also utilized to increase the reach and diversity of the sample. Persons age 18 or older who are involved in the care of an elder aged 75 or older, or the elder themselves were invited to participate in the study. This study was conducted under the review and oversight of the Beth Israel Deaconess Medical Center institutional review board (#2014P000296) using observational usability methods [13-14]. All study visits took place at BIDMC facilities, using the iOS InfoSAGE app (version 2.8) on a provided Apple iPad Pro. Participants' interactions with the screen were recorded by a camera as well as screen capture software. During the testing process, participants were asked to 'think-aloud' as they completed the study scenarios, in order to capture any reasoning behind their specific actions. Spoken comments were recorded and transcribed.

Eight scenarios of varying level of complexity were employed to capture common use cases for the medication manager feature of the InfoSAGE app. Participants were asked to add multiple medications with varying strengths, doses, and schedules. Both generic and name brand medications were included. Participants were also asked to utilize other primary features of the app such as drug-drug interaction notifications. No specific instruction was given from study staff about the study scenarios, nor were any participants shown how to use any feature of the app. If a scenario could not be completed due to difficulty, participants were given guidance on how to proceed. Participants used standardized instructions and scenarios, and did not enter any of their own, or elder's, personal health information.

Demographic and subject-reported comfort with the Internet was collected prior to beginning the study scenarios and an after-study survey was collected to evaluate the system and process. Participants were asked to rate on a Likert-type scale, with one

corresponding to 'Strongly Agree' and seven to 'Strongly Disagree', the ease of use, satisfaction with entry speed, the usefulness of in-app help, the difficulty of completion, and how useful the app would be as part of their informal caregiving. Semi-structured interviews were used to obtain further feedback from participants.

4. Results

All audio recordings were transcribed and thematically coded using an iterative process by a study staff member in consultation with the rest of the team. Codes and themes were categorized into five groups: Software response, user actions, user feelings, usability process, and task completion. Video recordings were analyzed using the Behavioral Observation Research Interactive Software (BORIS, v. 7.0.8), coded for events and themes and correlated to associated audio events. Time to complete each scenario was recorded, along with metadata such as the number of taps, use of in-app help, and frequency of mistaken 'clicks.' Observations were captured from seven participants involved in the care of an elder. Median age was 50 (2.5 IQR), and 71% were female. Demographics and self-reported skills are shown in table 1.

Table 1: Demographics, Survey Responses, Time to Complete (n=7)	
Age (Median, IQR)	50 (2.5)
Female (%)	5 (71%)
Ethnicity	
Hispanic or Latino	1 (14%)
Not Hispanic or Latino	6 (86%)
Race	
Black or African American	1 (14%)
White	6 (86%)
Level of education	
4-year college graduate	5 (71%)
Masters or doctoral degree	2 (29%)
What is your comfort level with using the Internet?	
Very comfortable	6 (86%)
Comfortable	1 (14%)
Do you currently care for an elderly family member? Yes	7 (100%)
On average, I access InfoSAGE: Never	7 (100%)
I would personally rate my skills with online websites as	
Intermediate	3 (43%)
Expert	4 (57%)
I would personally rate my skills with mobile apps as	
Beginner	1 (14%)
Intermediate	4 (57%)
Expert	2 (29%)
Questions (1=Strongly Agree, 7=Strongly Disagree)	**Mean (SD)**
Overall, I am satisfied with the ease of completing these tasks	1.3 (0.5)
Overall, I am satisfied with the amount of time it took me to complete these tasks	1.3 (0.5)
Overall, I am satisfied with the usefulness of the help for completing these tasks	1.8 (1.6)
How would you rate the difficulty of completing the task scenarios	1.7 (0.5)
Overall, after completing these tasks, I feel that this could potentially be used on a regular basis as part of my patient care/loved one's patient care and communicating my current list of medications with my care provider/loved one's care provider	1.2 (0.4)
Time to complete	14m04s

All participants were naïve users, having never used either the InfoSAGE website or mobile applications. Except for one participant, all self-rated their skills with mobile apps as intermediate or expert. All were familiar with the general use of the iPad. Each participant successfully completed all eight scenarios, with an average time to completion of 14 minutes 04 seconds. Familiarity and comfort with the app increased for each subsequent scenario after the first despite increasing complexity, and the average time to complete scenario two, the addition of warfarin (5mg tablet, by mouth, once daily) to the medication list, decreased by 37% when compared to scenario one, the addition of lisinopril (5mg tablet, once daily).

Audio and video coding uncovered confusion in the entering of medication details surrounding doses and strengths, and was the most consistent theme observed in all participants. Two participants suggested that the current method of entering medication (figure 1) "feels redundant." The app currently employs several fields that seem repetitive (use of dose and schedule, naming conventions) but allow for maximum flexibility in the recording of a wide range of medications, prescribing practices, and delivery methods (aerosol, injection, by mouth).

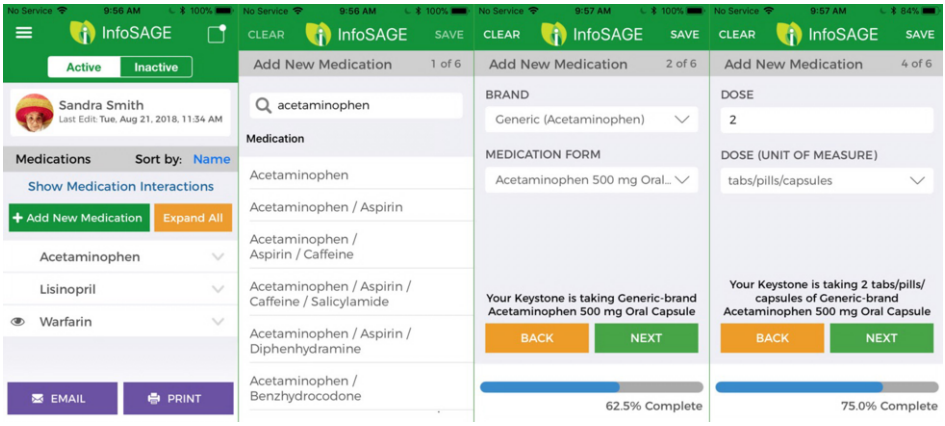

Figure 1. Adding a medication to the InfoSAGE mobile app, process flow

Terminology was a consistent source of questions, ambiguity, and hesitation throughout the scenarios. Two participants confused medication side effects with drug-drug interactions, and all but one participant had difficulty discovering where medication side effects were listed. The difference between generic and name-brand medications, and how they are listed through the app, also proved to be challenging for participants. Medications are loaded by searching the National Library of Medicine's RXNorm database, which also contains information about dose and strength. These strings are shown to the user for selection of the appropriate medication, but often contain details, including generic names, that must be confirmed on further screens. Lastly, the difference between deactivating and deleting a medication was a consistent point of clarification. Deactivating is used when a user stops taking a medication but wants to keep it on record, and deleting removes it. Despite these difficulties, participants also remarked on the ease of use of the app, and several expressed that the utility may be useful in their own informal caregiving. To the question 'Do you think that this system could possibly improve your mother's care', one participant stated:

"Yes, but not my mother's care. It would improve my sister and I -- our sanity. I think it would be more useful for us than for her, which in essence would benefit her. More for everybody to figure out what is going on."

Another participant indicated that the thoroughness of the medication entry process made her feel secure. As the user enters additional details, the app automatically constructs a summary sentence for that medication. Others requested additional features, or changes to existing features, another commonly observed theme:

"I'd like to see a planner, or daily schedule, or something. That would be useful, so what we've just done is only useful to the extent that it feeds into that. But you have to take nothing for granted."

Overall, participants were satisfied with the ease of completing the scenarios (1.3, SD: 0.5), the amount of time each task took (1.3, SD: 0.5), difficulty of each task (1.7, SD: 0.5), and the utility in their own caregiving (1.2, SD: 0.4).

5. Discussion

Our findings indicate that while users were able to use the app, there were difficulties in understanding both the content and the wide range of options to enter medications. The comments regarding the ability of users to understand the terminology, side effects and drug interactions suggest that more improvements are needed to respond to health literacy issues [15]. The drug information for elders and their caregivers will need to be further developed at a language level that more users can understand [16].

Design may help users distinguish differences between side effects and drug-interaction, such possibly using different colors and labels. Some users also expressed confusion on the various options for entering medications. By adding more functionality to the app we can support more possible scenarios of medication schedules, but we may be increasing the difficulty of the app for users that have simpler medication regimens. We will need to balance feature rich but usability poor tradeoffs. We may consider in future having a simpler entry form for rapid entry and a link to more advanced fields.

A few users also had some issues recognizing which items were buttons. This is in part due to the flat graphical style of the most recent release of the mobile operating system. Frequent changes by mobile computer makers to user interface layouts will cause problems for users with less computer experience and may be particularly problematic for older users that may have vision problems.

While there are some evaluations of mobile apps with elders [17-19], however the existing guidelines for user interfaces used by elder populations from international organizations such as The World Wide Web Consortium [20-21], The European Commission [22], and the US Government [23-24] have focused on web-based interfaces. Future research could strive towards a consensus recommendation on user interface guidelines for mobile apps for elder health applications with insights from academic groups, industry groups, elders and their families.

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