Usability Assessment of a Personalized and Adaptive Health Tool

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Abstract

This work describes the iterative design of a mobile health tool that provides personalized and adaptive health information to individuals with breast cancer. Individuals' cancer trajectories and information needs are extremely variable and continuously changing. However, few mobile health systems today offer tailored support that considers these differences. Further, little work has examined the usability of dynamic health tools. In this paper we describe our process for evaluating this adaptive health system and the design changes that emerged from the evaluation. This work offers important design considerations for those developing patient health management tools and offers a useful method for evaluating adaptive health systems.

Author Keywords

Mobile Health Systems; Cancer; Usability.

ACM Classification Keywords

H.5.2. Information Interfaces and Presentation (e.g. HCI): User Interfaces—user-centered design; J.3 [Life and Medical Sciences]: Health
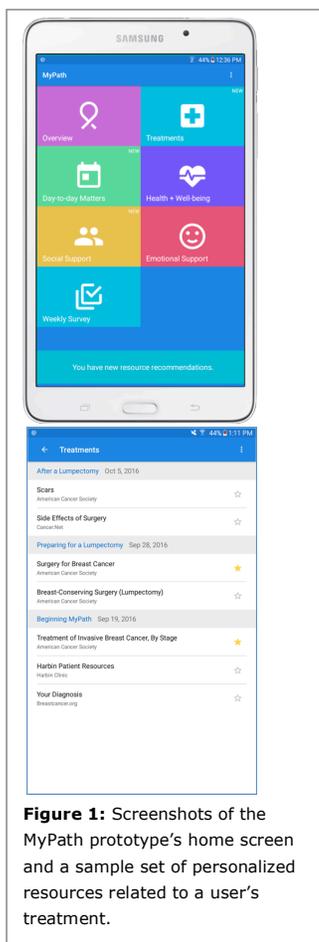
Introduction

A number of mobile health systems have been developed over the years to support individuals' healthcare management. For those undergoing cancer treatment, these tools can have important benefits. Mobile tools can help users feel in control of their care [7] and reduce symptom severity and distress [6,8]. However, despite the diversity of cancer journeys [4], many existing health tools offer a one size fits all approach, with each patient receiving the same interface to accomplish specific goals or tasks. This approach places the responsibility on the patient to filter through an increasing number of resources and information to determine those useful for their journey. This burden can negatively effect patients' health management [9], and decrease patients' psychosocial wellbeing [2]. Thus, a need exists for health tools that offer more flexible and personalized support.

We developed MyPath to offer personalized, adaptive, and comprehensive support to cancer patients as they progress from diagnosis through survivorship. The application presents each user with a tailored set of trusted health information based on the individuals' diagnosis, treatment plan, and user input about their personal challenges and barriers to care. As a patient progresses through treatment, the application continues to update the recommended health information to support their needs in that moment.

MyPath will be deployed as a part of a randomized controlled trial in Spring 2017. We expect that personalized health tools, such as MyPath, will help patients more effectively manage their health information, enhance their ability to cope with various cancer side effects and challenges, and improve their

psychosocial wellbeing. However, fundamental usability questions need to be addressed before deploying such tools in the wild. During the iterative design of MyPath, we ran usability studies with healthcare professionals and breast cancer survivors. Figure 1 shows screenshots of the MyPath prototype used during testing. In this paper we share the results of this work. We offer important insight for designing personalized systems within the healthcare context, as well as a method for evaluating the usability of dynamic health interfaces.

MyPath Design

Our partner oncologists currently recommend patients' visit three sources for health information: American Cancer Society, Cancer.net, and Breastcancer.org. Upon diagnosis, patients also receive a binder of printed material from these sources. The resources on these sites have a wealth of useful information to help patients cope with a range of medical and personal needs that often arise during cancer care. However, participants in our earlier studies were overwhelmed by the amount of information provided by the cancer clinic [5]. We developed MyPath to help patients navigate this large body of information.

MyPath uses a robust database of rules indicating for each individual information page whether it relates to a particular diagnosis, treatment, side effect, or other common challenge. As we describe below we use these rules to create a tailored set of information for each user that updates as they progress through treatment and based on user input. For the full study, we will deploy MyPath on android tablets with a suite of other useful applications for patients, including their personal

Figure 1: Screenshots of the MyPath prototype's home screen and a sample set of personalized resources related to a user's treatment.

calendar, email, and their personal health records. Below we described MyPath's main features:

Personalization: The system's content will be determined by the user's diagnosis and treatment plan, and updated based on input from the user regarding her or his health situation. When users receive their personalized tablets they will see a tailored set of information that provides details pertinent to their diagnosis. For example, if Mary is diagnosed with Stage II breast cancer and will be receiving radiation therapy, she will find links to information specific to Stage II and radiation. However, information that describes Stage IV breast cancer, for example, will not be included. This personalization will help to alleviate some of the stress patients feel as they navigate through the numerous cancer resources, many of which may not be related to their own situation.

We also have included a questionnaire within MyPath to allow users to share the medical and personal challenges they are experiencing as they arise. The questions come from two sources. Many of the questions are taken directly from the NCCN distress thermometer [1]. We developed additional questions based on our prior work developing a cancer journey framework [4]. Our healthcare partners vetted these additional questions. User responses to these questions will result in immediate updates to the MyPath content. For example, if Alice shares that loss of memory from chemotherapy is causing her distress, MyPath will provide new information for coping with memory loss.

Adaptability: MyPath includes a dynamic interface that updates content based on the user's current and upcoming phases of care. When a user transitions to a new treatment (such as ending chemotherapy and beginning radiation), or into a new phase of the journey (such as post-treatment survivorship), new information will be presented. For instance, in the week prior to beginning radiation treatment MyPath will help the user prepare for the transition, providing information about how the treatment is delivered, expected side effects, and questions to ask your doctor. The goal of providing this adaptability is to lesson many of the challenges that can arise during medical transitions.

Comprehensive support: An important goal in developing MyPath was to support users' clinical and personal needs. Cancer is only one part of a person's life; they are also balancing family responsibilities, job responsibilities, and many other tasks. Thus, we developed MyPath to support the whole person, not just the patient. The initial resources a user sees on MyPath are not limited to medical information. Information categories include: Overview (of breast cancer), Treatments, Day to Day Matters (such as transportation and financial assistance), Health and Wellbeing, Social Support, and Emotional Support.

Usability Assessment
Due to the limited work evaluating adaptive interfaces in the wild, particularly in a health context, the usability assessments for MyPath were critical for understanding any complications that arise from a dynamic recommendation system. We developed three scenarios to include in the usability test in order to demonstrate the changes to the content over time.

In the first scenario, participants were presented with information that would be displayed at the time of diagnosis. Participants were asked to reflect on either

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their own needs during this time, or common information needs of their patients before interacting with MyPath. This helped us to understand their expectations regarding useful health information. Participants were then instructed to open the application and find a resource that would be helpful to a newly diagnosed patient. To accomplish this task the participant needed to open the application, select a category, and then one of the information pages. Once completed, they were asked to identify two additional useful resources in other categories.

In scenario two, we presented participants with health information relevant to a patient who was beginning radiation in one week. Again, we asked participants to first reflect on the needs of patients at this point in the journey and then find three resources that they believed would be useful to a future patient.

In the final scenario, we asked participants to imagine they were in the middle of treatment and to complete the MyPath questionnaire. While the final MyPath application will suggest resources based on these selections, the prototype did not include this feature. Therefore, we asked participants to describe the types of information they would like to see appear.

During the usability study, participants also completed two short surveys. The first survey collected demographic information and asked participants to rate their comfort with technology, on a scale from 1 to 5. In the post-study survey, participants were asked the following questions:

- How easy or difficult was it to use the application (1:very difficult, 5: very easy)
- Were the resources you saw the ones you expected to see? (1:very unexpected, 5: very expected)
- Were the resources in the appropriate categories? (1:very inappropriate, 5: very appropriate)
- What did you like about the application?
- What did you dislike about the application?

Questions two and three allowed us to assess the predictability and accuracy of the dynamic content. Prior literature has shown that these two metrics can significantly influence user performance [3].

Usability tests took place in conference rooms at our partnering cancer clinic with one participants and one member of the research team. All usability tests were audio recorded. Two researchers transcribed the recordings and collaboratively identified themes across participants and identified necessary design changes.

Results
Participants
We ran usability tests with nine participants, including seven health care professionals and two breast cancer survivors. We included healthcare professionals due to their ability to discuss how a range of patients may use the technology, while survivors were able to provide input based on their personal experiences. All participants were female, with an average age of 50.7 years. The healthcare professionals included nurses, cancer navigators, and members of the Northwest Georgia Regional Cancer Coalition. These professionals on average had 16 years of experience working with cancer patients. Participants average technology comfort level was 4.1 (out of 5).

Category Selection

Across all participants, we saw no commonalities in the categories selected by participants during each scenario. Every category was selected at least once during the first two scenarios. The diversity of selections illustrates the importance of comprehensive tools that consider the broader needs of the individual.

Surveys

Once participants finished the three scenarios, they completed the post-study questionnaire. The results of these surveys were generally very positive. The average ease of use score was 4.3, with a minimum score of 4. The average predictability score was 4.1, with a minimum score of 4, indicating that participants felt the resources matched their expectations for useful information during each scenario. P9 even stated, *"it seems like those [resources] are sent specifically to me by the creators"*. The average accuracy score was 4.25. This showed that resources were categorized appropriately, though in the next subsection we discuss how the usability tests lead to the addition of a new category of resources.

In the open question about what participants' liked about MyPath, "*easy to navigate*" was the most common response. Participants were easily able to separate out new recommendations from old ones as they progressed through each scenario. When asked about dislikes, many wrote remarks about interaction areas, such as checkboxes being too small. Thus, we will be proactively setting up each tablets' accessibility features before deploying them to patients. Overall, the survey feedback did not indicate that the dynamic content interfered with the usability of the system.

Think Aloud Feedback

Participants' comments during the studies led to some important design considerations, described below:

Include local resources: All of the participants agreed that the resources included on the prototype were useful and appropriate. However, both of the cancer survivors shared how local support groups, such as bosom buddies and cancer navigators, were critical for improving their physical and emotional wellbeing. Several participants commented that the support services offered within the community are particularly important for recently diagnosed patients. Participants believed the MyPath system could be a useful tool for helping patients to find these services early in their cancer journey. Based on this feedback we developed a new category: Local Resources. This category includes information about cancer support services at or near the cancer clinic.

Make resources accessible offline: During the usability study, several healthcare professionals expressed concern about the accessibility and usefulness of the device for individuals without Internet access. We faced an interesting design trade-off when considering whether to use offline static content or online content. Offline static content may become outdated over time, as the primary information sources update their content. In addition, several of the resources included in MyPath are only usable when online, such as discussion boards. Thus, we revised our resource rules to indicate which resources are only available online. For the majority of the resources, we are storing the content offline so that patients may have continuous access. These offline files do provide links to the original web pages in order to allow for

additional information seeking when users are connected to the Internet.

When should adaptive systems make new recommendations? One goal of MyPath is to help users prepare for upcoming changes in treatments. In scenario 2, we asked participants to imagine that the resource recommendations were made one week before beginning treatment. We chose this timeframe in order to give patients time to look through new information without adding stress to the first day of a new treatment. All participants felt that this timeframe was appropriate. However, information related to radiation may be more effective when recommended on the first day of radiation or several days after radiation. Future work could examine the benefits of providing information at different times in the cancer journey.

Conclusion

This work presents a usability assessment of a personalized and adaptive mobile health tool. Our evaluation suggests that dynamic resource recommendations did not decrease the usability of the system. The final version of MyPath is currently being developed. A randomized controlled trial assessing the influence of the technology on patients' psychosocial wellbeing will begin in March 2017. This study will make important contributions to our understanding of how personalized health tools may better support individuals coping with long-term illness trajectories.

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