Evaluation of a Web-Based Telehealth System: A Preliminary Investigation with Seniors in New Zealand

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ABSTRACT

Home telehealth systems are gaining popularity among seniors, but they are mostly doctor centric, focused on managing diseases instead of preventing them, and do not take into account the social needs of the users. Increasing numbers of seniors going online opens up opportunities to address the shortcomings of current telehealth systems. We have developed a patient-centric, web-based telehealth system which uses Web 2.0 technologies to add social support and user defined content. In this study, we have evaluated the functionalities, usability and user interface of the functional prototype with eight seniors of age range 67 to 90 by using a multi-method approach involving individual walkthrough, system usability scale (SUS), protocol analysis and interviews. Overall, users were satisfied with the usability of the system and functionalities promoting exercises and supporting weight management were in most demand. The evaluation of our prototype demonstrates that combining telehealth functionalities with social component and user-generated content is a promising way to enable users to proactively manage and improve their health.

Categories and Subject Descriptors

H.1.2 [**User/Machine Systems**]: Human factors;
H.5.2 [**User Interfaces**]: User -centered design;
J.3 [**Life and Medical Sciences**]: Health

Keywords

Telehealth, human computer interfaces, seniors.

1. INTRODUCTION

Telehealth is increasingly seen as an efficient and cost effective means for improving patient care and employing healthcare resources more effectively. It meets the preferences of patients, especially seniors, to remain at their homes while receiving remote care and monitoring services from healthcare providers. Current telehealth systems are usually focused on treating diseases instead of preventing them and they suffer from high initial costs and vendor lock-in, thus requiring extra costs to add new functionalities. They also do not address the social and psychological needs of the patient [2, 10].

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The continued growth in the number of seniors going online [3, 4] indicates an increased utilisation of web-based resources, which provides opportunities to address the shortcomings of current telehealth systems. The emergence of Web 2.0 technologies makes it possible to develop sophisticated healthcare applications that provide social support to its users. For instance, PatientsLikeMe (www.patientslikeme.com), a popular website that has more than 100,000 registered members, provides access to valuable medical information aggregated from a large number of patients experiencing similar diseases. Research indicates a range of benefits from sharing health data online including the potential of improving disease self-management [12,13]. Other consumer oriented web-based health support applications include StartYourDiet, DailyBurn, DailyStrength, SugarStats and MyFitnessPal. Existing Web 2.0 health applications provide useful functionalities, such as diet and exercise monitoring, and formation of support groups. However, most of these applications are expensive, do not offer a comprehensive suite of functionalities, target often younger health consumers, and do not replace traditional telehealth platforms [9].

Based on the aforementioned shortcomings, we have proposed a framework for a more patient-centric telehealth systems called Healthcare4Life [2]. We have employed the framework to develop a functional prototype which was tested with real users.

The following two sub-sections introduce the purpose of the evaluation and the Healthcare4Life telehealth system. Section 2 presents the methodology used in conducting the study. Section 3 describes the results, which are discussed in Section 4. Section 5 concludes the paper and gives an outlook on future work.

Table 1. Formative Evaluation Key Questions (from [17])

1.	What are the most significant usability issues that are preventing users from completing their goals or that are resulting in inefficiencies?
2.	What aspects of the product work well for the users? What do they find frustrating?
3.	What are the most common errors or mistakes users are making?
4.	Are improvements being made from one design iteration to the next?
5.	What usability issues can you expect to remain after the product is launched?

1.1 Formative Evaluation

Any healthcare system ideally should be evaluated while it is being designed and developed to maximise benefits and minimise risks of deployment at the real setting [16]. Formative evaluation allows developers to reflect on a system prototype and helps to highlight

any design faults at an early stage, thereby facilitating the improvement of the system before it is ready for deployment. Table 1 lists key questions that can be answered with a formative evaluation.

Formative evaluations are typically conducted by involving end users in the system design process, which in fact is a crucial aspect for developing patient-centric systems [1]. Furthermore, hands-on sessions with real users are rewarding and often lead to more spontaneous suggestions for improvements of the product [7].

This paper presents a formative evaluation of a functional prototype of Healthcare4Life with a subset of real users. The main aim of the study is to assess the usability of Healthcare4Life, and ultimately improve the system based on the feedback from potential users. Findings of the study are expected to be useful to researchers and developers of web-based healthcare solutions, especially those targeting the senior population.

1.2 Overview of Healthcare4Life

Healthcare4life is an extendable ubiquitous patient-centric system that combines the power of social networking with telehealth systems in empowering patients, especially seniors, to manage their health independently from home. It aims to overcome the limitations of traditional telehealth systems, and envisions making telehealth more widely available, affordable and scalable. The system is being developed using Google's OpenSocial technology and Drupal CMS [15].

Similar to existing health 2.0 systems, Healthcare4Life tries to encourage positive lifestyle changes by letting the seniors manage their own healthcare goals. It promotes social networks over clinical networks to motivate users, especially seniors, to take control of their health and to address social isolation. Similar to the social networking applications discussed above, it serves as a medium of interaction between patients. Patients suffering from the same disease are able to share experiences, and engage in health-related activities (e.g. exercise) via the health applications available in the system.

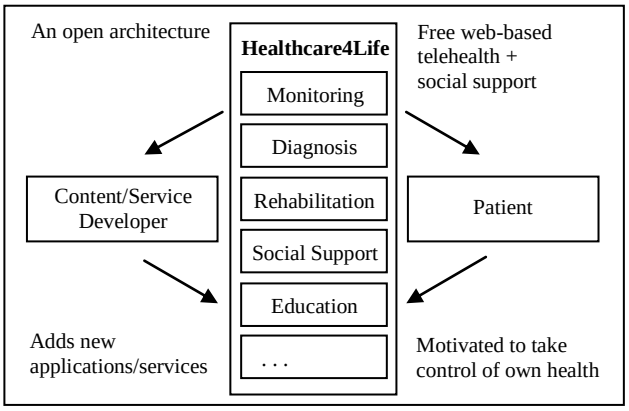

Figure 1: Overview of Healthcare4Life functionality (from [9])

Similar to Facebook, the system has an open architecture that enables third-party providers to add new content and functionalities (see Figure 1). Applications added into Healthcare4Life may fall into categories such as monitoring, diagnosis, education, rehabilitation and social support. Developers can design applications for these categories by using the OpenSocial standard in the form of serious games, interactive web pages and expert systems. Unlike existing social networking websites which mainly focus on 'just for fun' or advertisement-based applications, Healthcare4Life aims at attracting serious developers to build and share health-related applications with patients. Developers will get useful feedback from potential users through a ranking system, which displays user satisfaction and the popularity of each service.

To keep overheads low, the framework supports the usage of common consumer level HCI devices such as webcam, keyboard, iPhone, and Wii remote controller with the system. So far, we have developed two iPhone games that enable users to perform rehabilitation exercises for the elbow and shoulder joints [14].

Usability testing is a crucial aspect of the development process of Healthcare4Life, i.e. to ensure that the system meets their needs and expectations of the senior population. An initial user study conducted via semi structured interviews and a paper prototype confirmed that seniors are interested in such an application, and the results provided guidelines for the user interface design and system functionalities [6].

2. PROCEDURE AND METHODS

Individual evaluation sessions (lasting approximately 90 minutes) were conducted in participants' homes between January and February 2012. Prior to the usability testing, an overview of Healthcare4Life and its specific aims were presented. Participants then completed demographic data forms so that their background and computer usage could be learned. In the first part of the evaluation, participants were required to perform a series of tasks with Healthcare4Life with minimum assistance. Instructions were presented textually on a piece of paper. The tasks were grouped into 2 parts as illustrated in Table 4: (1) social networking, and (2) health applications.

It is apparent that there are various methods to assess the usability of novel web-based applications [18-21]. However, individually, these methods have their own strengths and weaknesses, which require careful consideration in making the selection for a particular study, especially for studies involving senior participants. For instance, the focus group method is reported to be less effective when dealing with seniors [22]. Therefore, as suggested by recent studies [1, 23, 25], a multi-method approach will help to gain a deeper understanding of the intended system as well as to offset the weakness of any one method with the strengths of another. Following this recommendation, we have used numerous methods in conducting the study which include the think aloud protocol, question asking protocol, questionnaires and interviews.

Participants were encouraged to think-aloud, and to verbalise their thoughts, feelings, and opinions while interacting with the system. This technique helped to better understand participants' thoughts and emotions while working with the system. Participants' verbatim comments and interactions with the system were recorded and analysed to identify potential areas for improvement. After each session, the video and audio recordings were transcribed to text and coded for data analysis. The question-asking protocol was used to complement the think-aloud method by asking direct questions about the system. For example, *how would you set your goal weight in the weight tracker application?*. This method proved useful to as it revealed participants' mental models as to how they perceived the system, and the problems they encountered in understanding and using the system.

Upon completing the tasks list, participants were requested to complete a post-test questionnaire which was divided into 3

sections: functionality, usability and user interface. For the first section, participants were presented with a list of functionalities of Healthcare4Life which they had to rank by order of importance. For this section, they were given 11 cards, labelled with a functionality of the system, to be ranked by order of importance. In the second section, a well known previously validated System Usability Scale (SUS) questionnaire [8] was used to assess the overall usability of the system. SUS is a simple 10-item Likert scale with standard labels (Strongly Disagree to Strongly Agree, ranging from 1-5) that provides a global view of usability. Table 2 lists the 10 questions of SUS. Participants' responses to these questions are calculated as a single score, ranging from 0 to 100, with SUS scores above 70 being described as acceptable usability level [24]. In the third section of the questionnaire, 10 specific questions related to the user interface of Healthcare4Life were presented.

Table 2: System Usability Scale (SUS) (from [8])

No.	System Usability Scale (SUS)
1	I think that I would like to use this system frequently.
2	I found the system unnecessarily complex.
3	I thought the system was easy to use.
4	I think that I would need the support of a technical person to be able to use this system.
5	I found the various functions in this system were well integrated.
6	I thought there was too much inconsistency in this system.
7	I would imagine that most people would learn to use this system very quickly.
8	I found the system very cumbersome to use.
9	I felt very confident using the system.
10	I needed to learn a lot of things before I could get going with this system.

At the end of the study, a short interview was conducted with each participant to gain further insights into their general perceptions about Healthcare4Life. Participants were presented with three semi-structured questions, including what they liked best and least about Healthcare4Life, and other features they would like to see.

2.1 Participants

Participants were recruited by posting advertisements in senior community centres, clubs and retirement homes. They were expected to be aged 65+ and to be able to use a web browser.

Table 3. Demographic Characteristics of Study Participants

Characteristic	N	%	Characteristic	N	%
Gender			*Uses Facebook*		
Female	5	62.5	Yes	6	75
Male	3	37.5	No	2	25
Ethnicity			*Uses a Self-care tool*		
European	6	75	Yes	2	25
Indian	1	12.5	No	6	75
Asian	1	12.5	*Living circumstances*		
Computer Usage			Alone	1	12.5
5+ days/week	6	75	Spouse/partner	7	87.5
1-4 days/week	2	25			

Research shows that conducting usability testing with five real users can reveal 85% of the usability problems of a system or website designed for a target user group [26, 27]. Furthermore, 8 to 10 participants are sufficient to identify and summarise the majority of usability problems and issues related to a health information system [5]. Therefore, the sample consisting of 8 senior volunteers (3 males and 5 females) between the ages of 67 and 90 (mean age was 77 with SD = 7.78) fulfilled the criteria for the usability study. They had basic computer skills and were selected based on the fact that they represent the intended potential users of Healthcare4Life. See Table 3 for other baseline characteristics of the sample.

2.2 Measures

Task success was used to measure participants' ability to perform the test tasks. Each participant's performance of each task was rated as follows: 0% - fails to complete the task and 100% - succeeds to complete the task. Task completion time was not measured since think-aloud protocol is known to impact tasks time [28]. Questionnaires were used to assess participants' satisfaction with the usability and user interface of the system. Participants' verbatim comments resulting from the think-aloud protocol and interviews were used to identify design issues.

2.3 Analysis

The verbatim comments and interviews were evaluated using qualitative content analysis. Usability problems identified via the coded text data were grouped according to Nielsen's 10 usability heuristics [11] with their frequencies noted. The frequency of a particular statement or similar statements was counted, and comments with the highest frequency were identified as important. Illustrative quotes were also highlighted. Video session recordings were carefully analysed to take note of participants' success rate in completing the tasks. The overall usability scores were calculated with the methodology of the SUS described previously [8, 24]. Additional Likert-scale items were analysed quantitatively.

3. RESULTS

3.1 Completion of Task List

During the evaluation process, each participant was required to complete 20 tasks related to usage of the Healthcare4Life. Apart from the social networking and health applications tasks, the tasks list included simple tasks such as signing up and logging out of the system. These tasks may seem trivial but helped to identify any difficulty faced by the user in locating the intended buttons.

Table 4 shows the success rate of the test tasks. Six participants (75%) were not able to change their password in the system (Part 1: Task 9). The link to change password was provided in the *Settings* page, which was made accessible via the *Settings* button located at the top right corner of the system. However, most of the participants ended up searching for such feature in their *Profile* pages. Some of them referred to the *Help* for guidance. It was apparent that they were expecting all features or pages to be accessible via the iconic horizontal menu. To overcome this problem, the *Settings* button can be included in the main iconic horizontal menu.

Four participants (50%) were not able to locate and add registered members of Healthcare4Life as friends (Part 1: Task 3). Although the *Search* icon was provided in the iconic horizontal menu, these participants were expecting this feature to be placed at the *Friends* page. To overcome this confusion, the link to the *Search* page can be provided in the *Friends* page.

Generally, participants did not face any serious problem in completing Part 2 of the tasks list. However, one participant was not able to login after logging out of the system. He had forgotten his password and was not able to retrieve it. This frustrated him as he had to sign up with the system again to be able to continue with the rest of the tasks. This problem can be fixed by enabling users to retrieve their passwords by email.

Table 4. Tasks List and Success Rate

Tasks	Successful n (%)	Unsuccessful n (%)
Part 1 - Social Networking		
1. Sign Up with Healthcare4Life.	7 (87.5)	1 (12.5)
2. Complete your profile.	8 (100)	-
3. Search for Sanggita and add her as a friend.	4 (50)	4 (50)
4. Accept Jaspal as a friend.	8 (100)	-
5. Send a mail to Sanggita.	7 (87.5)	1 (12.5)
6. From 'My Home', share a message with all your friends in Healthcare4Life.	8 (100)	-
7. Comment on Jaspal's message.	8 (100)	-
8. Remove Sanggita from your friends list.	7 (87.5)	1 (12.5)
9. Change your password.	2 (25)	6 (75)
10. Invite Sam to join Healthcare4Life.	6 (75)	2 (25)
11. Logout from Healthcare4Life.	8 (100)	-
Part 2 - Health Applications		
1. Log into the system.	7 (87.5)	1 (12.5)
2. Find and add the following applications to your application page: ▪ Weight Tracker ▪ Multiplayer Memory Game	8 (100)	-
Weight Tracker		
3. Enter your estimated weight.	6 (75)	2 (25)
4. View your weight graph.	8 (100)	-
5. Assuming that you entered the wrong value, edit the weight value you just entered.	6 (75)	2 (25)
6. Enter your goal weight.	7 (87.5)	1 (12.5)
Multiplayer Memory Game		
7. Play the game with Jaspal until all image pairs are uncovered.	7 (87.5)	1 (12.5)
8. Rate the application.	8 (100)	-
9. Delete your user account.	8 (100)	-

3.2 Functionality Results

Table 5 depicts the main features of Healthcare4Life in descending order of importance as perceived by participants. Participants were mainly interested in having access to health-related applications and viewing their health progress with easy to understand visuals such as graphs or charts.

Table 5. Functionalities ordered by Importance to the Participants

Functionalities	Mean*
Access to health-related applications	2.1
View health data using graphs/charts	3.3
Track the total amount of body & mind exercise	4.3
Send a message to a friend	4.9
Play social games with friends	5.5
Add and remove applications	6.5
Search for friends and invite others to join *Healthcare4Life*	6.8
Add and remove friends	7.5
Keep caregiver/family member informed about activities in the system	7.8
Perform/view application ratings	8.6
Facebook-like comment feature	8.9

** Low Mean value means more important*

The ability to track the total amount of physical and mental exercises performed, although not included in the functional prototype, seems to be an important feature to participants.

Interestingly participants did not enjoy having a Facebook-like comment feature. Participants got distracted with the '*What's on your mind*' text box from the health focus of the system. Although most of them have used Facebook and were familiar with this message sharing feature, they were not sure what to share with their friends in the Healthcare4Life network. Most users only shared things related to their health.

The ability to perform and view application ratings does not seem to be important to users. We observed that participants were more interested in an application's description than its average rating when deciding which application to add to their profile. Keeping a family member or caregiver informed about their activity is also given less importance, as the majority of the participants (87.5%) were living with their spouses or families. However, most participants commented that this feature would be very useful to seniors who are disabled or living alone.

3.3 System Usability Score

Participants rated the usability of the system positively. SUS scores corresponding to participants' responses are presented in Table 6. The scores ranged between 65 and 97.5, with a median of 71.25. The average SUS score is 75, which means that the overall usability is rated as '*Good*'.

Table 6. Individual SUS Scores of the Participants

Participant No.	SUS Score	Adjective Rating
1	65	OK
2	70	Good
3	65	OK
4	70	Good
5	85	Excellent
6	75	Good
7	72.5	Good
8	97.5	Excellent

3.4 User Interface Results

Results from the questions related to the user interface of Healthcare4Life are shown in Table 7. The results indicate that the participants are generally very satisfied with the user interface of the system. This could be due to the fact that Healthcare4Life is presented with a simple iconic horizontal menu at the top which helps users to identify the key functionalities of the system (see Figure 2). Results show that this is a good design, as it is handy to users, especially to novices.

Figure 2: Sample Page from *Healthcare4Life*

The icons and buttons are presented with both graphics and text to aid users to quickly understand what they need to do. For instance, an envelope icon is used to represent the mail function.

In terms of color, Healthcare4Life is presented with different shades of green for the top banner, main menu and footer. The colorful icons were made to aid users to visually identify them easily. The main content area (excluding the health applications) is maintained white throughout the system, to enable users to read clearly and focus on the content.

3.5 Usability Problems

From an examination of the data collected from users' responses to the questions posed in the think aloud sessions, usability problems were classified according to 10 heuristics and are listed, with their frequencies, in Table 8.

Frequencies depicted in the table shows that each heuristic was violated at least one time. Most usability problems were grouped under the *User control and freedom* heuristic with total of 12 occurrences. This was followed by the *Match between system and the real world* with 8 occurrences. From the 20 identified problems, *Not able to locate the changing password page* (75%), *Incomplete/misleading labels* (62.5) and *No information about what is username* (62.5) problems yielded highest frequencies. To overcome these problems, the system will be adjusted accordingly. Firstly, the *Settings* button will be made part of the main menu, which will contain the list of all the necessary pages (e.g. link to the page to change password). The identified incomplete or misleading labels will be changed as suggested by the participants. For instance, it was suggested that *Email of Care Giver* in *Profile* page should be changed to *Email of Family member/Care Giver*. Since most participants face problems in understanding the term username, description of this term (with an example) will be provided next to the username text box at the sign up page.

Table 7. User Interface Results

No.	Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	% Agree*
11	The horizontal menu appearing at the top makes it easy to identify the key functionalities of the system.	3	4	1	0	0	87.5
12	The information on the site is organised clearly.	1	6	1	0	0	87.5
13	The icons helped to find things in the site faster.	3	5	0	0	0	100
14	It is easy to navigate through the website.	0	7	1	0	0	87.5
15	The graphics on this web-site are visually pleasing.	1	7	0	0	0	100
16	The color scheme used for this website is appropriate.	2	5	1	0	0	87.5
17	The fonts are easy to read.	3	4	1	0	0	87.5
18	The links and buttons in the website do what I expect them to do.	1	7	0	0	0	100
19	The used icons represent the corresponding functions well.	1	6	1	0	0	87.5
20	I feel lost when using this website.	0	0	2	6	0	0
21	The text on the website is easy to understand.	2	6	0	0	0	100

**Percent Agree (%) = Agree & Strongly Agree Responses combined*

Table 8. Classification and Frequencies of the Usability Problems

Heuristic violated	Problem description	Frequency (n = 8)
Visibility of system status	No confirmation that an application was added successfully	2/8
	No indication that the memory game was loading	1/8
Match between system and the real world	The country list box not listed alphabetically	2/8
	Incomplete/misleading labels	5/8
	Misleading message box in memory game	1/8
User control and freedom	Slow load time	4/8
	Not able to locate the changing password page	6/8
	Not able to locate the adding friends page	2/8
Consistency and standards	Misleading/unnecessary *back* button in the application directory page	4/8
Error prevention	Unexpected errors (codes)	3/8
	Undetected error	1/8
Recognition rather than recall	Unable to retrieve password	1/8
Flexibility and efficiency of use	Desire to have the *settings* button to be part of the main menu	4/8
	Goal weight in weight tracker application to be based on BMI	2/8
Aesthetic and minimalist design	Unnecessary message box when accepting one as friend	3/8
	Unnecessary Facebook-like comments	3/8
	Irrelevant information about new friends of a friend	1/8
Help users recognize, diagnose, and recover from errors	Unnoticed validation messages	1/8
Help and documentation	No information about what is username	5/8
	No information about number of characters expected for password	2/8

Apart from good design and layout, it is essential to ensure that the content presented in the system is easy to understand by users. The amount and suitability of content is an important incentive for frequent use of such a telehealth system. For Healthcare4Life the number of applications will grow in time, as application developers start to add content into the system. It is necessary to keep a good balance between the usability and functionality of a system [11]. Expanding functionality typically results in a more complex system, which we identified as a factor reducing suitability of many existing Web 2.0 health applications for seniors [6]. The health applications of Healthcare4Life are grouped in an application directory. Patients can add desired applications from this directory to their profile and remove them at any time, i.e. enabling them to decide the amount of functionality they would prefer for themselves. Such features help to keep a good balance between the usability and functionality of the system.

3.6 Results of Interview

Participants provided feedback about what they liked most and least about Healthcare4Life, and gave recommendations for improving the system. Table 9 provides all of the questions asked during the interview, along with responses and their frequencies.

Table 9. Interview Questions and Responses

Question	Response	n
What are the things you liked best about Healthcare4Life?	- Simplicity	3
	- Stress about health and growing older	3
	- Weight graph	3
	- User friendly	2
	- Memory game	2
	- Social contact	2
	- More fun than Facebook	1
	- Colorful initial page	1
What are the things you liked least about Healthcare4Life?	- Facebook like comments	3
	- Time consuming on computer	1
	- Sending messages to friends	1
	- Slowness to surf across screens	1
	- Use of the word elderly, instead of senior	1
	- Picture on homepage	1
What other functionalities you would like to see in Healthcare4Life?	- More health applications (reminders, diet, exercise, vitals)	4
	- Add settings button as one of the main buttons	4
	- Compare health problems	2
	- Add Sudoku and Crosswords	1
	- Show who is online	1
	- Health information e.g. desired heart rate for age	1
	- Links to health sites (e.g. MedPlus (NIH))	1

Results from the interview shows that most the participants liked the simplicity of the system and the personal weight graph. On the contrary, they were not keen about having the Facebook-like commenting feature. There were suggestions to include more medical and health-related applications. Applications generally should promote exercise and enable users to manage their diet. There were specific requests to include applications supported by easy-to-understand graphs that will enable them to track their blood sugar level and blood pressures. Apart from having more health applications, there were strong recommendations to make the settings button accessible via the iconic horizontal menu.

4. DISCUSSION

The main aim of the study was to assess usability and functionality issues of the prototype of Healthcare4Life so that we could improve the next version of the system accordingly. Along with the usability issue, we were interested to know which functionalities of the system are most important and least important to potential users. This information and personal recommendations from the

participants helped to confirm the user requirements for Healthcare4Life.

Results from the cards sorting activity and interviews strongly indicate that seniors want to see more health-related applications in the system. Access to a variety of health applications is the main motivation for patients to use Healthcare4Life. This implies that to design a successful web-based telehealth system, it is necessary to have a variety of health applications that meet unique needs of patients. A web-based telehealth system should be designed with an open architecture, enabling developers to contribute content. Based on our observations, most of the participants were keen on using both of the sample applications provided in the system, i.e. the *Weight Tracker* and the *Multiplayer Memory Game*, which were designed to be self-explanatory and easy to use for seniors.

The high SUS score of Healthcare4Life indicates that the Web is a suitable medium to deliver telehealth solutions to seniors with some web browsing experience. Based on our observations and the interview results, it was apparent that participants were favourable towards the idea of using a web-based telehealth system to manage their healthcare. The idea of involving family and friends in their healthcare was very well received. Participants were positive about the potential of the system, especially the attempt to tackle social isolation, which is a serious concern among seniors living independently. Nevertheless, they are quite aware that web-based telehealth solutions are complementary interventions and not meant to substitute primary care.

There is strong indication that imitating the Facebook-like comment feature does not work for healthcare systems. The seniors also did not like to receive updates such as who is a new friend of their friend in the system. Health related systems are generally seen as more serious applications by users. Therefore, the commenting feature could be used, mainly because people are familiar with it, but it should serve a clear purpose, such as to enable patients to encourage each other in managing their own health. For instance, after playing a memory game, patients might feel encouraged to share their scores with their friends in the network. Such sharing may be useful for patients to receive encouraging or positive comments from their friends. This idea was suggested to the participants during the interview session and was well received by them.

One of the participants made an important statement concerning the use of a computer for personal healthcare. Computer-based health applications generally require users to spend long hours in front of a computer and cause them to be less active. This is a common phenomenon which could cause patients, especially seniors, to stay away from computers. Therefore, it is crucial to focus on applications that promote exercise and physical activity. Consumer-level motion sensing devices such as iPhones, Wiimotes and Kinect can be leveraged for improving users' healthcare by delivering innovative and effective exercise-based health applications. As such, a telehealth platform should ideally be ubiquitous and do not physically constrain users to a computer.

Seniors want easy access to all the functionalities provided in the system. The ability to change password or to make changes to privacy settings are typically not visibly located in most websites. Results from the tasks completion show that most of the participants were not able to change their passwords in the system. It is crucial to make such features easily accessible to users, especially seniors. Therefore, it is recommended to have a *Settings* page that is clearly made visible to users along with other functionalities provided in the system.

Based on participants' comments and our observations, it was clear that seniors generally expect immediate feedback for every little action they do in a system. They are generally more concerned, suspicious and careful about their interactions with a computer. They expect clear guidance in the system. For instance, if they have added an application from the application directory, they prefer to see a confirmation message indicating that they have added the intended application successfully. Such messages keep them informed and in control.

From the video analysis, it was clear that when participants were not able to do a particular task, they tried to look for help in the system. Therefore, proper help functionality in the system is necessary. As suggested by two participants, the help feature could be in the form of a Frequently Asked Questions (FAQs). Video tutorials were thought to be useful for uncommon features in the system (e.g. the health applications). However, written guidance is preferred over video tutorials, especially to aid seniors with hearing impairments.

Similar to other web-based health systems, Healthcare4Life uses a patients' username to identify them in the system. Most of the participants were confused about this term, which is the first thing they should enter when they register with the system. Such labels should be clearly described in the registration form and the user should be able make changes to such inputs easily in the system.

The choice of terms used in the system raised minor, but interesting issues. For instance, the term *friends* used in Healthcare4Life represents people added by patients for a variety of reasons, such as to share health experiences, play social games and to keep in touch. One participant was concerned about the appropriateness of this term for the system, since a friend is someone whom you can depend on and call to share something. The term *contacts* was suggested as replacement, since it embraces everybody, including family. Another participant thought that the term *friends* is more suitable than *contacts*, due to its familiarity to people after being widely used in Facebook.

There are a few limitations to be noted of this study. Firstly, although we believe that the participants of this study are representative of the potential users of a web-based telehealth system, the sample size used is relatively small. Although the mathematical model of Nielsen indicated that five real users are sufficient to detect majority (85%) of the usability problems of a website [26], other researchers have argued that a larger sample is necessary to obtain reliable data. Secondly, due to the shortage of resources and time, only seniors with basic computer experience were engaged in the study, as they were anticipated to provide useful feedback and recommendation to improve the system.

5. CONCLUSION AND FUTURE WORK

The growing number of seniors online allows developers to utilise the Web as a medium to deliver affordable and effective telehealth solutions. We have developed a web-based patient-centric telehealth system, Healthcare4Life, which emphasises social networks rather than clinical networks. We have tested the functional prototype with a group of seniors to identify design issues and to gain insights into their perceptions of the system. Results of the study indicate that seniors with basic computers skills were able to successfully use the system. Our analysis provided general design recommendations that can be considered in the development of web-based telehealth and seniors driven health systems.

Results of the formative evaluation will be used to enhance the system. Subsequently, an extensive long-term evaluation with seniors (with and without computer experience) will be done at senior community centres with a larger sample size to determine the overall satisfaction of the users and efficacy of the system in meeting intended goals.

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