Designing User Friendly Mobile Application to Assist Cancer Patients in Illness Management

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Abstract— **Mobile terminals are well suited for providing information to patients at the point of need. In the CONNECT (Care Online: Novel Networks to Enhance Communication and Treatment) project, we have developed a mobile application, called Mobile WebChoice, as a part of a patient support tool that enables patients' access to a help and support system while they are away from hospital between treatments and during rehabilitation and recovery periods. Through our work we address research questions regarding: development of a user-friendly mobile application, user's expectations and requirements from the patient support system, and usability issues that affects acceptance of mobile applications in patients' health management process. We have used participatory design methods that included interviews and usability testing with patients and health personnel. As a result, we identified main usability requirements that must be taken in consideration when developing and adjusting patient support systems for mobile access and saw that patients find the mobile application useful and the patients are ready to accept it as an integrated part of their health management process.**

Keywords- mobile application development; health management; patient support system.

I. INTRODUCTION

Due to the increasing costs related to health and long-term care and higher demand for healthcare personnel, there is increasing need for innovative methods and new approaches in interacting with healthcare services [1]. Mobile technology can offer great advantages for access to healthcare information. Widespread acceptance of mobile phones and their ability to provide access to services independent of time and user's current location make mobile terminals well suited for timely delivery of healthcare services to healthcare providers and patients.

Also, patients are becoming more and more involved in the management of their own healthcare conditions with support and help from healthcare professionals [2]. Using new technologies they become more informed about their current conditions and care process, and can become an important participant in the process of planning and management of their own care. Mobile devices can enable patients to collect, store, and transmit clinical data to healthcare professionals and provide better and more complete insight in their health status.

This paper is organized as follows: Section II gives a brief overview of related work, Section III presents research questions we are addressing in our research work, Section IV describes research methods that are utilized together with results received through the mobile application development, Section V describes results from usability testing, Section VI presents discussion of the results and finally, Section VII gives a summary and conclusion of our research.

II. RELATED WORK

There are numerous projects that address utilization of mobile phones in healthcare management and it is shown that mobile phones can provide help for patients to understand the effects of their illness and treatment, and at the same time find a balance between seeking professional care and depending on their self-care abilities (e.g., [3][4][5]). Some researchers also describe how patients accept mobile health applications and feedback from patients regarding functionality and ease of use (e. g., [6][7][8]). Besides the research related to feasibility of mobile health applications and their potential to provide better patients' health management, we found less research addressing functionality and usability issues that have to be addressed during the development process (e.g., [9][10]). What we still found missing is research regarding more complex patient support systems, where patients are able to access the system over different terminals (mobile, PC, tablet PC). Most of the work addressing this issue in the healthcare area is describing development of mobile applications intended to be used by healthcare personnel (e.g., [11][12]). Some general guidance for developing and adapting a mobile application to a web version as [13][14][15] is present, but still we did not find the work addressing usability and mobility in the context of health support tools intended for patients use. We see that these systems are very specific, and users' needs can vary greatly from one person to other, so developing a system that is not just useful but also easy to use and adapted to users' specific needs and different terminal capabilities is very important for acceptance of the service.

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III. RESEARCH QUESTIONS

As part of the CONNECT (Care Online: Novel Networks to Enhance Communication and Treatment) project it is developed an Internet-based support system for communication and information sharing between and among patients and care providers, and patients are enabled to access the system over different terminals (tablet PCs, stationary PCs, laptops or mobile phone). Through development, adaptation and testing of the system and its components our main goal has been to identify key factors that are related to successful adoption, implementation and maintenance of this kind of tools in a real world practice. In this paper we are addressing research issues regarding development process, adaptation and integration of a mobile application in a patient support system. The main research questions that we address here are: (1) what interface requirements and adjustments are needed for the mobile application to provide patients with context-sensitive, adaptive interfaces and seamless, easy access to healthcare information independent of their current location, (2) how does previous knowledge and experience with other parts of the patient support system affect understanding and operation of the mobile application, (3) what are patients' opinions regarding mobile access to the health support systems and the application's usefulness and ease of use, (4) what are patients opinions regarding acceptance of the mobile application as one type of access to the health support system in their own health management.

IV. THE DESIGN AND IMPLEMENTATION METHODS

To address set research questions we utilized participatory design methods that included interviews and usability testing with patients and health personnel. Phases of the process are: development and evaluation of the application interface design, low fidelity usability testing with patients, development of an user interface, expert reviews and high fidelity usability testing with patients. In this section we will describe each phase in more details.

A. Previous work

Previous to our work, the support tools Choice and WebChoice are developed as part of the CONNECT project [16]. The Choice tool enables patients to report their symptoms, health problems and concerns while in the hospital, rate the degree of distress and prioritize their needs for care from health care providers. The WebChoice tool allows patients to monitor symptoms through the Internet over time, and provides access to evidence-based self-management options tailored to their reported symptoms as well as a communication area where patients can ask questions to a clinical nurse specialist and exchange experiences with other cancer patients. After development of these tools, the next step in the project was to investigate how the support system could be enhanced with mobile access, enabling use independent of time and place. It was decided that only a limited set of functionalities from the WebChoice application should be made available in the mobile application (messaging, registration of problems and an advice module) due to limitations of mobile terminal, and the first draft of design screenshots was developed.

B. Development and evaluation of the interface design

In the first step of the mobile application development we revised and adapted the first version of the application design screenshots that are developed in previous phase of project. We used general guidelines that we found in the literature (e.g., [17][18][19]) and in the same time tried to follow the recommendation given from mobile device and mobile operating system manufacturers (e.g., [20][21][22][23]).

One additional requirement that we set for our specific case is adaptation of the mobile application interface to be similar to the web version (some of the guidelines that we used are described in [13][14][15]). In this manner we adjusted the interface not only for general users but also to users with previous knowledge of other parts of the system and to provide them the feeling that they are accessing the same system through different terminals.

We adapted interface design screenshots using previously mentioned guidelines, but at the same time tried to find a good balance between general recommendations for mobile application design and specific requirements set for this type of applications. Some of the usability issues from the previous design version that we addressed and corrected are: provision of information to users regarding content on the screen (using scrollbars to give feedback about additional content that is not visible on the screen, and enabling users to always know where they are in the application through status bars and titles), consistency in name and place of commands (using just two-three standard commands per screen require us to keep consistent patterns and clear names) and text size adaptation (finding right balance between text size and amount of information on the screen to provide good readability).

C. Review of interface design by patients

When the main interface design screenshots has been created and reviewed, we organized usability testing with the low fidelity paper prototype. In the usability testing four patients participated [24]. During the test participants looked at nine interface screenshots representing different functionalities of the mobile application. They were asked about their opinions regarding the interface design (size of the text, colors, organization of element on the screen) and understanding of the interface functionalities.

Some conclusions from participants' feedback are:

1) When adapting interface from bigger screen to smaller, choosing the content that should be transferred requires cooperation with users and finding out what are their expectation from the specific system. For this type of systems we saw that all text that present description and do not give extra knowledge to users should be omitted (or transferred to a specific help page). For example, the login screen should be without introduction text and menus should contain just main command's names (without any clarifications).

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2) Transferring extensive menus with deep structure on one screen (as in web applications) is not acceptable in the mobile application. The better solution is to make submenus, but there are still problems in connecting a few screens to correspond to the functionality of menu selection in a web application, and find the right level of granularity and amount of information to show per screen. To solve this problem, we used icons identifying the hierarchical menu level.
3) Having in mind that the amount of information per screen is very limited, it is very easy for the user to get lost in the application and do not understand what to do next. Providing users feedback regarding current place in the application help, but additional adjustments of menus and screens using familiar concepts from the web application helped the user to transfer previous user experience to the mobile application.
4) Even though content and concepts from the web application is transferred to the mobile application, in some situations it is better to adjust screens to more resemble standard mobile functionalities, like text input, menu organization and command organization. Other interface elements, such as colors and application specific icons should not be changed.
5) When adapting interface for small screens, the usage of right colors is very important. Colors on one hand could enable additional emphasis on more important interface elements, but just transferring the same colors from a web to a mobile version could result in low readability and clarity. In our example we saw that users had problems with reading text in bright color on dark background as implemented on the web version.
6) Selecting the right text size present important issue as we saw from previous steps, because there is need for a right balance between text size and amount of the text on the screen. From the users' feedback we saw that using one font size through all application is not good approach, but rather the size should be adapted depending on the screen size, resolution and amount of information on the screen.
7) Using icons and images should be very limited. If they are used just for descriptive purpose, and do not provide any other additional information to users they should be omitted (for example in menus when used in addition to the text). On the other hand in some situations it is convenient to use them to show some status or information to the user on the manner that is similar to the PC or other mobile applications (e.g. status about mail).

We saw that some of the results are in accordance with general mobile user interface development recommendations, but others are very specific for utilization in the context of the mobile applications in healthcare.

D. Development of the mobile application

For developing the mobile application we used Java Platform, Micro Edition (Java ME) [25]. The choice of the Java ME developer platform enabled us to make user-friendly and well-designed user interface adjusted for the majority of mobile terminals.

During application development we used mobile design screenshots that are developed in previous phases. Also while the mobile application was in the development phase, a new design interface was implemented for the WebChoice application; so the design of the mobile application was also adjusted to it keeping in mind previous gained knowledge about users and their specific needs. During development we made the application to dynamically change the interface according to the screen size of the device, so the main organization of the text on the pages stays the same regardless of the mobile device the application is running on. We also additionally addressed the problem of font size by making the user interface more comfortable for reading of longer texts. For example, if a patient reads text describing a self-management advice, he/she is able to change the font size, font type and orientation of the text and in this manner adjust it for better readability. This is normally not possible in a Java ME environment, which only support one font and 3 sizes. Our goal was to make the interface flexible and readable regardless of mobile phone limitations, like screen size and limited navigation possibilities. Additional adjustments are also made so the mobile application can support touch screens without a specific keyboard on the device.

We decided to develop a basic design of our application according to some general design recommendations as stated previously, but in this phase of development process we also implemented some device specific adjustments to change dynamically based on the device type. For example, in our application the right soft key command is used as a rule as back button (that is recommended in the guidelines for Nokia phones) but for writing text in input fields characters assigned to input keys are dynamically adjusted to device type.

For development of this kind of mobile application, using just standard Java ME libraries do not provide enough flexibility. To overcome this limitation, we used the Faster Imaging library [26] that enables virtualization of the mobile terminal. The program library offers improved visual display quality, improved font handling and performance for image and interface intensive applications and is designed to execute on top of all Java ME virtual machines supporting Mobile Information Device Profile (MIDP) version 2.0 and Connected Limited Device Configuration (CLDC) version 1.1 available in almost all Java-enabled phones. A key challenge for us was to provide handling of text and images on a mobile device, with minimal requirements to the terminal, and using the proposed architecture we succeeded to leverage different character fonts and provide virtual machine independent display with low processing requirements, since only very basic operations and only integer arithmetic is used. Text is represented in a highly

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compressed format that enable faster rendering. The readability and visual quality is preserved down to very small character size by performing "smooth-edge" technology that provides anti-aliasing with special attention to color blending, consistent view quality independent of rotation and scaling, scalable line thickness and non-isometric text handling.

E. Expert reviews

After prototype has been finished, we organized expert reviews with nurses that were involved in development and research work on other patient support tools, and are well acquainted with the Choice and WebChoice applications.

We utilized a heuristics evaluation and recruited four evaluators [27]. Guidelines that evaluators used for testing are based on the recommended heuristics for web applications [27], and we added heuristics specially addressing mobile device and mobile application characteristics found in [19][28].

The four evaluators were given the list with heuristics and short pre-evaluation session was conducted where the heuristics are explained in more details. They were asked to test the application in duration of one to two hours and note all nonconsistencies with the guidelines. After testing we organized a short debriefing session where evaluators described their experience of the process, and presented their results. Based on received feedback final corrections and adjustments were made on the application before start of a usability testing with patients.

Most of the feedback we received was regarding small interface adjustments, and more convenient organization of the content on the screen. Also, additional propositions were made to name commands more clearly and according to their specific functions and context in which they are used. Additionally, adding advanced features for the application navigation is proposed.

F. Usability testing

When we finished all previously described phases in the application development process, and addressed all usability requirements and problems that were identified we continued with a high fidelity usability testing with patients. A couple of screenshots of the mobile application that is used in the usability testing are shown in the Figure 1.

In this study we performed the usability test of two application scenarios. In the first scenario participants performed testing on just the mobile application, while in the second scenario participants performed testing first on the web application on the PC before they started testing on the mobile version. In the study participated ten patients, five for each application scenario. User group of ten patients is not large enough that represent general user population, but we think that it is large enough to get some first feedback regarding usability issues, acceptance and user needs from mobile applications used as part of the patient support tools.

The study was conducted on a Nokia 5310 phone with installed Mobile WebChoice application and access to the Internet. The test was conducted one participant at the time

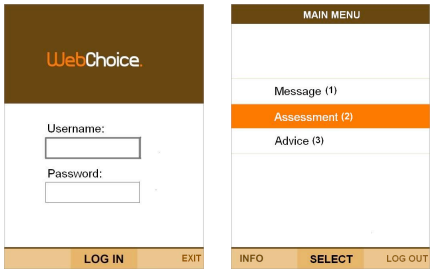
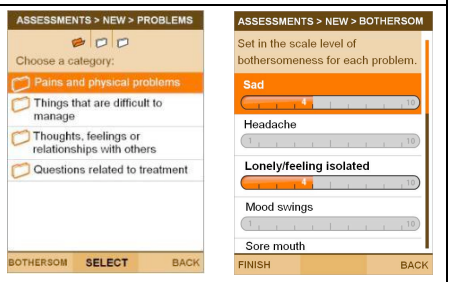
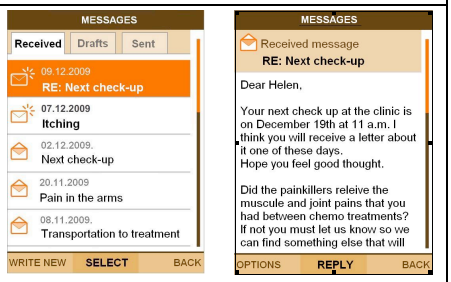
Module	Screenshots
Login and main menu	
Registration	
Messaging	

Figure 1. Screenshots of the application's modules.

in an enclosed environment with minimum background noise.

1) Test Process Design and Data Collection Method

On the beginning of the test participants were briefly introduced on the objectives on the study and the CONNECT project. They were informed that they would be recorded on a video while performing tasks for later analysis. Also, they were asked to try to perform tasks on their own, based on their previous knowledge of the mobile phones and computers, and to take time as they think it is needed. Participants were asked to think out loud during the tasks, and if unavailable to progress on a given task to ask for a help, but only after trying to perform the task first on their own.

The group of participants that tested both the mobile and web version of the application first received the list of tasks to perform on the web application on a desktop PC. After performing the tasks on the web application participant continued with mobile application testing.

Prior to the mobile application testing, participants performed pre-training exercise on the mobile phone. The task list was then given to the participants. During the test, every participant has been asked to perform a total of seven tasks. The tasks were grouped in four groups, based on the main functionalities of the application. For each task the

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time, number of errors and number of requested help were measured. Between the tasks and at the end of the testing participants were asked the set of questions to gain more subjective and qualitative feedback regarding interface design, general impressions regarding the application and it's usefulness and acceptance in their everyday health management, and answers and comments were recorded. The groups of tasks were designed as follows:

- Login to the application (task 1)
- Send the message to the nurse (task 2-3)
- Register specified problems (task 4)
- Find advices regarding previously selected and specified problems (task 5-8).

2) Targeted respondents

All participants in the study were women between 30 and 60 years old and in treatment for a breast cancer. Only one participant previously heard about the CONNECT project, and participated in previous organized usability studies. Average age of all participants was 46.5 years (average age for first group that tested just the mobile application was 49 years, and the second group that tested the mobile and the web version was 44 years). All of participants owned their mobile phone, eight owned Nokia phones, one Sony Ericsson phone and one HTC phone. According to their subjective opinions the eight participants had average previous experience with mobile phones usage and the remaining two participants had above average user expertise with a mobile phone.

V. RESULTS FROM USABILITY TESTING

In this section we present results recorded during the usability testing.

A. Quantitative results

The task completion times for both user groups are illustrated and compared in the Figure 2. We can see that for the most of the tasks completion time vary by the small values. The only higher variation in the task completion time can be observed for the task four (registration task).

In the Tables I and II are presented numbers of errors participants had while performing tasks and number of times they requested assistance while performing tasks. Here we also see the highest difference for the registration task.

TABLE I. NUMBER OF ERRORS

Task number	1	2	3	4	5	6	7	8	Sum
Mobile version	0	0	0	2	1	2	0	0	**5**
Mobile and Web version	1	0	0	0	0	1	0	0	**2**

TABLE II. NUMBER OF REQUESTED ASSISTANCE

Task number	1	2	3	4	5	6	7	8	Sum
Mobile version	3	0	2	12	1	3	0	0	**21**
Mobile and Web version	4	0	1	4	0	1	0	1	**11**

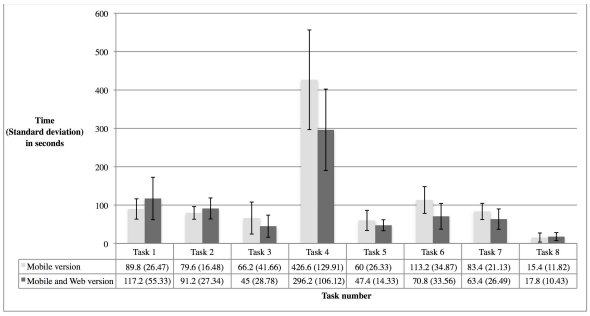

Figure 2. Task completion time for both user groups.

B. Qualitative results

Through the qualitative feedback we tried to identify main usability problems.

1) Task analysis – Login to the application and main menu

In general, participants did not have many complaints and problems regarding login functionality. Participants that owned Nokia phones managed to identify option for changing a text input type very quickly, but others requested help before completing the task. This problem was previously identified so the key for changing the text input type is assigned dynamically in the application dependent on the type of the mobile phone the application is running on. That was one of the limitations of the study because participants did not test application on their own phone, which would offer them probably more familiarity with the standard mobile phone functionalities. One participant suggested that it would be useful for her to have a dictionary option while writing a text.

All of the participants understood the main menu. Some of them commented that it is very simple, clear and easy to understand. For the six participants size of the text was good for reading, and four commented that they do not have problems reading but they recommend little bigger text to facilitate reading for them and for other potential users. All of the participants were satisfied with used colors, and just one complaint that the soft key menu is too dimmed.

In the main menu we used shortcuts (that are presented as numbers in the brackets after the menu item names) and enable more experience to move through the application more quickly. Three participants understood the meaning of numbers as shortcuts.

2) Task analysis – Send the message to the nurse

All participants understood the organization of this functionality and they were satisfied how it is working. It was very easy for them to find all the functions and perform required tasks. Two participants that tested the web application earlier stated that it is very good that the mobile version is similar to the web version. One also stated that it is very good that standard mobile phone functions are used, so she was already familiar with key functions like text input.

Just two participants have stated that they would prefer bigger letters while for others the size of the text was good

for reading. Three participants had problems identifying an option for writing a new message. One complained that the soft key menu is dimmed and other suggested to make this option more visible by emphasize it. All of participant also stated that now when they know where this option is they would not have problem using it.

3) Task analysis – Register specified problems

All of the participants were satisfied how organization of the problems were implemented. One that used the web version previously stated that it is very similar to how registration is organized there, and "if one see it on the big screen it is easier to recognize and understand it on the small screen also". Two of the participants stated that they were a little confused, but if they will use this application regularly it would be easier to perform this task.

All of the participants were satisfied with the text size, and one just commented that it could be little bigger but then there would be less space for the text on the screen and that would be a bigger problem for her.

Just one participant stated that the task was little complicated for her (she used the web version previously) but the rest of them said that the task was not complicated. Also they said that they would be able to perform it again.

Three participants had problems finding the option for going to the next step in the registration process (two that used just the mobile and one that used the web version also), but this was more because they did not know and/or did not remember the name of the next step. Other participants stated that they did not have problems finding option for the next step, and one said that "this way is very similar to an usual use of mobile phones and very intuitive."

4) Task analysis – Find advice regarding previously selected and specified problems

None of the participants had major complaints and problems performing tasks in this module. All of the participants said that they think it is not difficult to perform tasks. Four of them stated that they had little problems understanding it for the first time, but still thought the tasks was not difficult to perform. All of the participants said that they would be able to perform the task again. One participant said that "it looks much like the standard options on a phone", so she did not have problems finding the right options.

In the application we implemented functionalities for changing font size and orientation of the text when there is much text on the screen, and seven participants stated that they see these options very useful and that they would use them. Two said that they personally would not use these options, but still think that they are useful for others. One said that she would not use it and she thinks it is not so important.

5) Qualitative results – application usefulness and acceptance

After testing the mobile application most of the participants were very satisfied how it is working and seven of them stated that they think the mobile application is useful and that they would use it for monitoring their health condition. One of them said that if she has a web application available she would prefer to use the web application instead, but if not she would use the mobile application because she finds it also useful. One stated that she would not use the application because it is too slow for her, but if it was faster she would probably use it. One stated that she is not sure if she would use it and that she would have to try it and see.

When asked about usefulness of the application all the participants stated that they think the application is useful. Two participants said that today they use paper and pen to note when they have some problems and questions, and afterwards use this list as a reminder during consultation with the doctor. In these situations they think this kind of patient support system would be very useful because it will help them not to forget questions for doctors and nurses. Two participants stated that they do not want to call the hospital when they have minor health related problems because they are not sure how serious the problems really are, and access to this system could provide them first guidance and feedback if they need to make a trip to the hospital. Two participants stated that they liked the fact that the mobile application is always available, because they are not often in situation to use a PC. They said that now they have more free time, so for them using the mobile application would be very convenient. One participant stated that a positive side of the application is provision of a large amount of good and quality information that could help her monitoring her condition from one day to another, and not to just focus on a current problem.

VI. DISCUSSION

From the previous results we can see that the majority of participants are very positive regarding the mobile application as part of patient support system, and most of them think the application is very useful. After the first contact with the application most of the participants thought that if they are given the opportunity they would use it to monitor their health condition in addition to the web version. Most of the participants stated that they would prefer the web version, but they would use the mobile version if they do not have a PC with them. Also, they identified some advantages of the mobile version and found possible scenarios and situations where the mobile application could be more usable. There is also a question, if they would use the mobile application more if they were provided just mobile without web access. To find acceptance of just a mobile version, a new application should be developed that is optimized only for mobile operation.

From our usability testing we saw that users were able to use the application also when they did not have previous experience with the web application, but previous knowledge and experience help them in understanding functionalities better and performing tasks in shorter time period. Based on this, we do not recommend making a mobile application similar to a web-based application, but the interface should be familiar. We recommend to use the same colors, command names, menu items and icons/logos, but the presentation and interaction should be different, and leverage the capabilities of the mobile terminal.

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From the qualitative feedback we gained participants comments and thoughts regarding functionality modules, and identified usability problems, additional requirements and expectations that could influence acceptance of the system. The module that had the biggest difference in quantitative measurement was the registration module and we tried to use qualitative feedback to identify the reasons for this. As we saw that there were no major usability complaints, we concluded from participants' comments and video recording that the major issue was that they did not understand the registration process and they did not read the introduction text that were given to them on the screen before the registration process started. They stated that the interface for each step is organized well, and the command for going to the next step was not hard to find, but the problem was to understand what is the next step that should be performed. This explains also difference in completion time, because participants that had performed the task before on the web version knew which options to look for going to the next step of registration. From this we saw that a more detailed description is needed in the beginning of the tasks, so the process is understood before registration is started. Additionally, when creating instructions and support documentation this module should be addressed carefully and in more detail.

We saw that the functionalities provided in the mobile application should be a subset of functionality offered by the traditional web or pc/tablet application. In this way, the application can be very simple, providing only the most important functionalities that are suitable for mobile use. One patient stated: "Basics were there. For me, as a not so frequent user of a mobile phone, it is very important to keep the application simple. Too many choices would probably make it more complicated and I would get lost."

From the participants' feedback we saw that following traditional design guidelines for development of mobile applications is not sufficient when creating a user friendly and intuitive application. General guidelines are often in contradiction to each other (especially if they are from different mobile OS or phone manufacturers) and it is difficult to identify which guidelines are important. This is why we have proposed a selection of general guidelines, which has shown to be important to users during our patient-based testing. We suggest balance of requirements such as providing back options, consistency of command names, feedback to user where they are in the application, and organizations of menus. In addition, we have proposed new guidelines for adaptation of a general mobile application across terminals. This includes adapting size of the text dependent of amount of content of the screen; avoid the use of icons and text for additional descriptions, allowing users to change font size and orientation of the text, and the use of shortcuts. One issue that we specially addressed during development of the application was finding the right balance between size of the text on the screen and amount of information on the screen. Most of the users were satisfied with the selected text size. Some of them stated that having little bigger font would be even better, but that would affect readability of the text. From this feedback and the previous experience from the application development process we conclude that in the situation where there is large amount of text on the screen, it is better to use smaller text size and in this manner make text easier to read and understand. On the other hand, where there are just menus or small amount of information, it is better to use bigger font size.

The platform developed in the project provides unique support for adaptation to any mobile terminal, without requirements for a particular screen size. New methods for text manipulation has been developed, and as an example, we support arbitrary fonts with arbitrary size scaling in the application and the platform can adapt to most navigation methods, as for example navigation buttons, stylus, soft-keys, only numeric keys, and even touch screens in a consistent way. Thus, all patients can use their own mobile phone, and the application maintains an intuitive look and feel across terminals.

We finally observe that the mobile application is more suitable for younger people that are more acquainted with mobile technologies. One participant suggested that this application is most appropriate for the user group from 20 to 50 years. Our impression from this study where the mean age of participants was 46,5 years with average experience with mobile technology is that the application is very well accepted, easily understood and not seen as too complicated for everyday use.

VII. CONCLUSION AND FUTURE WORK

In this paper our main goal was to show the main user's requirements, expectations, acceptance and usefulness of a patient support tool that is accessible over mobile phone in addition to a web version. For development of the mobile application we used participatory design methods where we involved patients, usability and design experts, and also health providers that are well acquainted with patients needs. We saw that the mobile application we developed has good acceptance by a group of ten breast patients that participated in our usability study. We saw that most users accept a mobile application in addition to a web or tablet application. We think this is a very important fact, because until now mobile applications are often developed as a stand alone patient support tool and all system functionalities are provided through just one application. We recommend that a mobile application should be just a part of a more complete system including other types of terminals such as web or tablet for home/hospital use, and identifying guidelines for mobile application design and functionalities represent a new area in development of patient support systems.

We see that there are certain limitations and shortcomings in our usability study that can be addressed through future work, such as performing usability testing with a larger user group with different age ranges. Valuable feedback could be also gained from potential users with special needs, for example people with vision and motoric problems. Our plan for the next stage in the project is to start a pilot study where the group of patients will be offered both the mobile and web version of the support tool, and study differences in usability, usefulness and usage patterns.

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In [29] it is described results of a clinical trial that showed "less symptom distress, depression, and better self-efficacy for the patients that used Internet support system through the WebChoice application". We have proposed a selection of design guidelines for mobile applications for health care, and how the application should be aligned to existing web and tablet applications to improve usability and flexibility. We claim that an intuitive mobile application is an important part of a health management system for patients, and may result in faster recovery and better flexibility for patients and higher efficiency of healthcare providers.

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