

Get Moving - the Practice Nurse is Watching You!

A case study of the user-centered design process and testing of a web-based coaching system to stimulate the physical activity of chronically ill patients in primary care.

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Abstract—This paper describes the development and testing of a web-based coaching system. The system informs the practice nurse about the level of physical activity in daily living of patients who are using the *It's LiFe!* tool. Nurses can monitor patients via a secured website. Patients' physical activity is measured in minutes per day compared to pre-set activity goals. The goals are set by the nurse in dialog with the patient. To increase the probability of effective use, the coaching system was developed and tested in an iterative way, following user-centered design principles. The needs and preferences of practice nurses were determined through qualitative research. Automatically generated feedback messages were defined based on the requirements of practice nurses. The usability of the system was evaluated in a laboratory situation. The results from these tests gave insights into how to improve the structure and the quality of the information of the system.

Keywords— *user-centered design; persuasive technology; physical activity; self-management support; primary care.*

I. INTRODUCTION

According to guidelines and care standards, stimulating physical activity is an important element in the treatment of people with a chronic disease such as chronic obstructive pulmonary disease (COPD) or type II diabetes (DM) [1][2]. In the Netherlands, the majority of chronically ill patients are treated in primary care. They visit the family practice regularly to monitor their condition and it is the task of the practice nurse to provide lifestyle counseling during these consultations [3][4].

The use of technology for long term monitoring and feedback could support patients in achieving a more active lifestyle and could also help practice nurses to coach patients in establishing this behavioral change more easily. An example of a technological lifestyle intervention is self-monitoring of physical activity using a pedometer or an accelerometer. Although this has been identified as an effective approach towards behavior change, it is not often used in practice [5][6]. In the project *It's LiFe!* (an acronym for Interactive Tool for Self-management through Lifestyle Feedback!) an innovative monitoring and personalized feedback tool was developed and tested. The tool aims to support patients in achieving an active lifestyle as part of

their self-management [7]. The tool consists of three elements:

1. a 3D accelerometer worn on the hip;
2. an application (app) on a Smartphone;
3. a server and a web application called 'It's LiFe! monitor'.

The patient receives three types of feedback on the mobile phone concerning the amount of activity, the amount of activity in relation to an activity goal, and the response of a practice nurse based on the measured activity.

In this paper, the emphasis is on the third element: the development and testing of the server and the web-based coaching system used by practice nurses in primary care.

The involvement of users in the development and testing of technologies is associated with significant benefits such as: the generation of ideas by users; an improvement in system designs and user interfaces; considerable improvement in the functionality, usability, and quality of the system; access to and knowledge about user perspectives [8]. Furthermore, early and on-going user involvement and a close fit with organizational priorities and processes are important because attention paid to socio-technical factors maximizes the likelihood of successful implementation and the adoption of the technology [9].

Therefore the aim of this study was to examine the user requirements for the *It's LiFe!* monitor and to test the extent to which practice nurses were satisfied with the system. The following research questions were posed:

- What are the user requirements for the coaching system from the perspective of a practice nurse?
- How do practice nurses rate the usability (user performance and satisfaction) of the developed system?

In this paper the methods and some preliminary results of the development and testing of the monitoring system will be described and plans for the upcoming years will be explained.

II. METHODS

A user-centered design strategy was chosen for the development and testing of the tool, the coaching system and the Self-management Support Program (SSP), the behavior

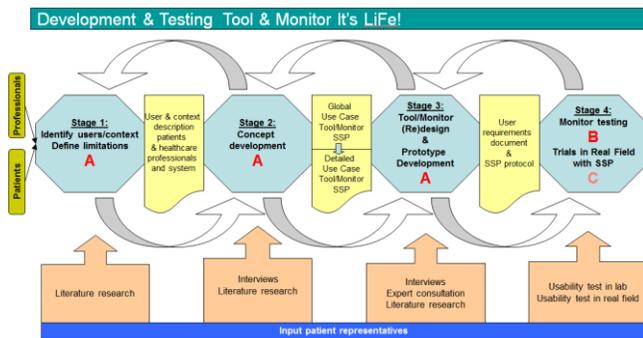


Figure 1. Iterative user-centered design model.

change counseling protocol for practice nurses. This strategy was based on several existing models for the design of medical devices [10-12]. The model is depicted in Figure 1.

From November 2010 to September 2012 three sub-studies were undertaken: a user requirements study (A), a test of the system in a laboratory situation (B), and a pilot study (C). In this paper some preliminary results of studies A and B will be presented. The studies were successive in time, but user-centered design requires iteration, which is why some results of the final study revealed new user requirements additional to the results of the first study. The optimization of the system is therefore an on-going process which started with a general project idea.

This project idea was developed together with several experts and business partners. It was based on a literature review of studies on coaching patients to achieve a more active lifestyle [13–18]. Subsequently a ‘use case’ was written [19] from the perspective of a practice nurse. A use case is a narrative scenario comprising a description of four main elements (PACT): the people involved (P), their activities (A), the context (C), and the technology used (T) [20]. The use case was a description of the use of the coaching system by a practice nurse coaching a patient in achieving an active lifestyle who started using the tool.

A. User requirements

A qualitative study was undertaken using semi-structured, audio-taped interviews in two iterative cycles to determine the user requirements of the coaching system.

Sixteen interviews with care professionals, directly involved in the care of patients with COPD or DM were held. In the interviews, the care professionals gave their opinions of the use case, different aspects of the coaching system and the use of the system in daily practice.

The interviews were transcribed verbatim and the data were analyzed, using the QSR NVivo 2 software package, following a directed content analysis method [21][22]. General themes emerged and these themes were used as input for the user requirements document.

Based on this document, the system was built in collaboration with two companies: Sananet Ltd developed the web-based system as part of a special program (It’s LiFe! monitor) in an already existing system (SananetOnline) and IDEE/Maastricht Instruments Ltd provided the upload of the

data from the It’s LiFe! app on the Smartphone to the Sananet server.

B. Usability

The system was tested at Maastricht University by five practice nurses to reveal the utility (whether the system provided the necessary features) and the usability (whether the user interface and content areas of the system were easy and pleasant to use) [23][24]. Practice nurses were asked to perform six tasks while using the system and to give their opinions of the manual. The tasks were:

- registering a new patient;
- viewing an individual client chart;
- setting a daily target;
- viewing the progress report;
- changing the threshold;
- sending a new username and password.

There was no further explanation of the system beforehand, but the participants could use the manual which was organized in chapters corresponding to the tasks. While performing the tasks, they were asked to give comments (think aloud method) and afterwards they provided their feedback for each task and indicated the difficulty of the task on a scale from 1 (very difficult) to 7 (very easy). The sessions lasted approximately 1–1.5 hours, were directly observed by the researcher involved and videotaped. Two laptops were used with the Morae usability assessment software (Techsmith, Inc., Okemos, MI) to record the participants (Figure 2). At the end of all the tasks, the nurses were asked to complete the Post Study System Usability Questionnaire (PSSUQ), a questionnaire with 19 items [25]. Finally, to get an impression of the desirability of the system, participants were asked to mark five words from a list of 118 words (product reaction charts) that in their view best characterized the system [26]. This list was translated into Dutch independently by two researchers. Descriptive statistics and simple content analyses were used to organize the data into categories that reflected the emerging usability themes. Frequently occurring errors were scored by analyzing the video tapes. Based on the results of the usability tests, system improvements were made.

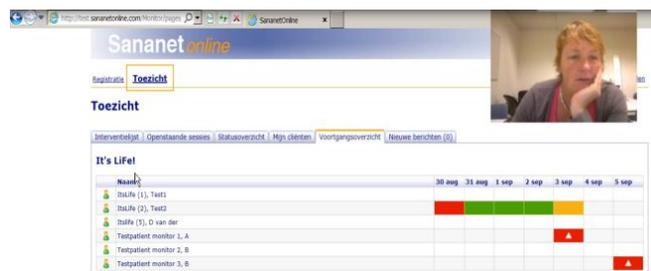


Figure 2. Screenshot of the usability study using Morae.

III. PRELIMINARY RESULTS

A. User requirements

In Table I an overview of the characteristics of the interviewees is presented.

TABLE I. INTERVIEWEE CHARACTERISTICS

Characteristics of the Interviewees			Number
<i>Profession</i>			
Practice Nurse	(PN)		7
Diabetes Nurse	(DN)		2
Pulmonary Nurse	(PN)		2
General Practitioner	(GP)		3
Physiotherapist	(PT)		2
<i>Age</i>			
Years (Range)			42 (26–58)
<i>Sex</i>			
Male			4
Female			12
<i>Treating patients with</i>			
COPD			6
DM			4
Both			6

The following clusters of user requirements emerged from the interviews.

1) *The opinion of the interviewees towards the use case*
 Most interviewees liked the idea that using the tool would give both patient and practice nurse the ability to monitor physical activity levels. They confirmed the added value compared to self-reported activity because patients often overestimate their level of activity. The use case suggested a mix of the use of technology and extra consultations. Most interviewees indicated that use of the tool should be part of care as usual; the extension of consultation time was not appreciated. Interviewees stressed the importance of goal setting being part of supporting self-management. Furthermore they indicated that the goals should be flexible, tailored to the individual situation of the patient, and that comorbidities of patients should be taken into account when setting a goal.

2) *The role of the practice nurse in stimulating physical activity*
 Although a sedentary lifestyle is often seen with COPD or DM patients, most practice nurses indicated that they normally do not spend much time on the assessment of the level of physical activity during consultations. Therefore, the use of this tool by patients to assess physical activity levels objectively during the first two weeks was considered valuable. Furthermore, interviewees suggested that were a diary for patients part of the system, this would give more insights into the normal activity patterns of the patients.

3) *How the information generated by the system should be presented in order to support the practice nurses in their work*

Practice nurses wanted to use the coaching system during consultations and therefore the activity data should be clearly represented within the information system they normally used in the practice or it should be linked with this system. A lot of nurses complained about using two or more systems and they wanted to avoid “double registration”. Furthermore, the coaching system should present a summary of all information about all their patients’ adherence and goal attainment at a single glance, using numbers and graphs.

4) *The integration of the system in the workflow and the opinions of practice nurses about giving feedback in between consultations*

The majority of the practice nurses were not enthusiastic about giving feedback on the physical activity levels of patients in between consultations. Only a few mentioned that they would probably monitor activity levels to find out if the patient was actually using the tool. They did not by any means want to receive push information, such as notifications from the system.

After these interviews it was clear that providing feedback in between consultations was too much to ask of the practice nurses and therefore it was decided to provide patients with automatically generated feedback messages from the coaching system. Furthermore, automatically provided dialog sessions were developed to support the practice nurse and the patient in preparing for a consultation.

5) *The coaching system*

Based on the user requirements that were identified, the *It’s LiFe!* monitor was developed. The systems consist of a server with two portals, one for care providers (www.sananetonline.com/monitor) and one for patients (www.itslife.nu). The practice nurse subscribes the patient to the system. The login name and password are sent to the patient by mail. At home the patient has to complete an additional questionnaire online (session) concerning physical activity preferences. At 6 a.m. the Smartphone automatically connects to the *It’s LiFe!* server to store the physical activity data for the past day on the server. There is a pre-measurement period of 14 days. In the second week, the patient receives short sessions every day to keep a diary. These can be accessed both on the Smartphone and on the website. Furthermore, there are two sessions concerning targets and activity planning. The nurse can see the answers given by the patient in the system on the individual chart of the patient (Figure 3).

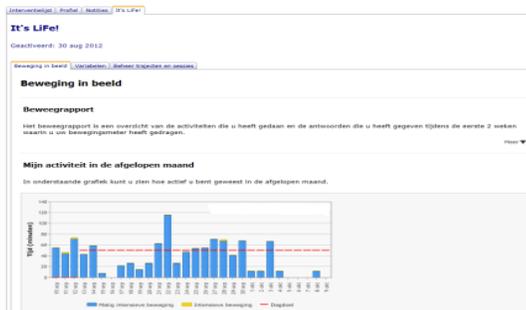


Figure 3. Screenshot of an individual patient chart.

After two weeks a daily target goal is set in the system by the practice nurse in dialog with the patient. Based on the physical activity data, the patient receives feedback messages. There are several types of message (tips, encouragement, positive trend, rewards, barriers, facilitators, and adjusting goals/target values). Participants get such messages when they reach or do not reach their goal after 3, 5 and 14 days. All messages are written in a positive tone, e.g., “Good that you still try to be more active. We can see that it is hard to reach your daily target. If you want to adjust your goal, contact your practice nurse or click here.”

B. System Usability

All five practice nurses who were invited took part in the test sessions. They were all female and their mean age was 45 years old with a range of 31–54 years. They agreed to the sessions being videotaped. Only one participant was unable to complete all the tasks because of time constraints. At the start of the test session the accelerometer and the Smartphone were demonstrated to inform the nurses about the patients’ part of the system.

1) Results of task performances and feedback on the manual

Some of the participants used the manual all the time and others only when they were in doubt. Although it was the first time participants had used the system, they were mainly positive about the ease of use.

TABLE II. TASK PERFORMANCE

Task Performance		
Tasks scores ^a	N	Mean(SD)
Register a new patient	5	6.6 (0.5)
View an individual client chart	5	5.8 (0.8)
Set a daily target	5	5.6 (1.5)
View the progress report	4	5.5 (1.0)
Change the threshold	4	5.5 (1.9)
Send new username and password	4	6.3 (1.0)

^a Scores range from 1 (very difficult) to 7 (very easy)

Scores on task performance ranged from 5.5 to 6.6 on a scale from 1 to 7 (Table II). Furthermore, the participants indicated that the manual was understandable and readable.

2) Results of observations and measurements during task performance (errors)

When registering a new patient in the system, three participants used the back button of the web browser instead of the back button in the system. This caused an error with the connection to the server. Furthermore there was one small button (more▼) in the individual charts with more information about the preferences of patients which was overlooked by four of the five participants. Finally, sometimes the system was slow due to internet connectivity problems.

3) Participants’ remarks

Most remarks made by the practice nurses related to the structure and the quality of the information.

Structure of information:

- The system is organized in four different layers (subpages). Many practice nurses commented on the difficulty of navigation. *Practice nurse, aged 41: “I get lost in this system.”*
- Participants asked if it were possible to remove subpages which were not necessary for the coaching of physical activity (e.g., a medication chart).
- The opening page of the system is a progress report on all participating patients, but two practice nurses preferred to see the individual charts of the patients because in their opinion these charts give the most important information (users had to click three times to open the individual charts).
- There were two types of remarks about the individual charts: the most important information should be presented at top of the page and this page was too long (users had to scroll to see all the information).

Quality of information:

- Participants liked the use of the graph indicating the level of activity over the past months and they were satisfied with the content of the individual charts. They said that it was useful information and that this could support them when talking to the patients during consultations.
- The progress report was not very clear to the participants; although an explanation of the different colors was part of the manual, four practice nurses preferred to see this explanation in the system as well.

TABLE III. RESULTS PSSUQ

PSSUQ		
Scores ^a	N	Mean(SD)
Overall PSSUQ	5	5.4 (0.8)
System Usefulness	5	5.6 (0.8)
Information Quality	4	5.3 (1.2)
Interface Quality	5	5.7 (0.8)

^a Scores range from 1 (strongly disagree) to 7 (strongly agree)

4) Results from the PSSUQ

The results of the PSSUQ (Table III) were also positive and equivalent to the remarks of the respondents concerning the information provided by the system. The overall score of the PSSUQ was 5.4 on a scale from 1 to 7. Scores on the subscales were 5.6 for System Usefulness, 5.3 for Information Quality, and 5.7 for Interface Quality.

5) Results of the product reaction wordlist

From the 118 words of which the respondents could chose, the following five words to characterize the system were chosen twice: “professional”, “motivating”, “valuable”, “customizable” and “innovative”. Most words selected were positive. Only two negative words were chosen: “slow” and “time-consuming”. An overview of all the words is represented in Table IV.

IV. CONCLUSION AND FUTURE WORK

The *It's LiFe!* monitor was built for practice nurses to support self-management of physical activity by chronically ill patients in primary care. Different components of the system were based on the user requirements of practice nurses, such as the development of automatically generated feedback messages. The iterative approach during the development resulted in a system which was appreciated by the practice nurses. The results of the usability tests gave insights into how to improve the structure and the quality of the information provided. As a next step, the system will be evaluated in two general practices as part of a self-management support program. Finally a randomized controlled trial will be set up to measure the effects of the tool and the coaching system embedded in the self-management support program.

TABLE IV. PRODUCT REACTION WORD LIST RESULTS

Product Reaction Word List*					
1	Enthusiastic	Novel	Professional	Stimulating	Interesting
2	Confident	Convenient	Familiar	Motivating	Valuable
3	Approachable	Customizable	Innovative	Relevant	Slow
4	Innovative	Motivating	Personal	Professional	Valuable
5	Clean	Controllable	Customizable	Essential	Time-consuming

* Words in bold were chosen twice

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www.idee-mumc.nl
- Maastricht Instruments Ltd. Oxfordlaan 70, 6229 EV Maastricht, the Netherlands
www.maastrichtinstruments.nl
- Sananet Care Ltd.
Rijksweg Zuid 22A, 6131 AP Sittard, the Netherlands
www.sananet.nl

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