Results of the Usability and Acceptance Evaluation of a Cardiac Rehabilitation System

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Abstract. Cardiac rehabilitation programs are extremely important during the recovery phase of patients who suffered a Myocardial Infarction (MI). Traditionally, these programs aimed at recovering the cardiovascular functioning by means of tailored exercise programs. However, during the last years, researchers and practitioners have started to consider a multi disciplinary approach for the interventions, where patient education and health behaviors changes play a central role both in rehabilitation and in secondary prevention. Nevertheless, the lack of resources and the need to have health professionals continuously involved in the patient supervision process, does not make possible to extend rehabilitation programs to all potential patients in the health care system. This paper presents the results of the usability and acceptance validation of a personalized home based cardiac rehabilitation system developed under the framework of HeartCycle, a project partially funded by the European Commission.

Keywords: Usability and acceptance evaluation, cardiac rehabilitation.

1 Introduction

Myocardial Infarction (MI) is a leading cause of morbidity and mortality in the world. According to the World Health Organization (WHO), an estimated 17 million people died from cardiovascular disease in 2005, 7.2 million of them due to heart attacks. If current trends are allowed to continue, it is estimated that 23.6 million people will die from cardiovascular disease by 2030, mainly from heart attacks and strokes [1]. The American Heart Association and American College of Cardiology recommend following cardiac rehabilitation programs after suffering a myocardial infarction, as they increase patients' chances of survival. These programs are specifically designed to help patients' recovery after a heart attack, from other forms of cardiovascular disease or after surgery to treat heart diseases. They are often divided into phases

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involving monitored exercise, support and education about lifestyle, all designed to help patients regain strength, prevent their condition from worsening and reduce their risk of future heart problems [2].

This paper presents the results of the usability and acceptance validation of a system aimed to support the cardiac rehabilitation process of coronary artery disease patients after suffering a myocardial infarction. The system has been developed within the scope of the HeartCycle project [3], partially funded by the European Commission under the 7th Framework Programme.

HeartCycle applies ICT to provide patients who suffered a heart attack with a complete solution that helps and supports them during the recovery phase. It offers a comprehensive cardiac rehabilitation program and personalized plans designed to be followed by patients at home. The solution not only includes an exercise plan for physical recuperation, but also tackles potential risk factors and lifestyle changes through innovative education and motivation techniques.

2 Technical Approach

HeartCycle solution comprises an elaborated cardiac rehabilitation program supported by a technological platform that includes systems both for patients and health care professionals. The professional system helps physicians to supervise patient's evolution during the rehabilitation process by allowing them to set up personalized care plans, regularly update them and conduct the appropriate follow up on their progress. Care plans encompass the prescribed exercise sessions for the whole rehabilitation period, including details on frequency, duration and level of effort to be achieved for each of the phases.

The patients system consists of three different devices: a PC application or patient station, a portable unit (PDA) and a sensor for monitoring vital signs. The patient station includes a complete set of functionalities that they can use to successfully accomplish the complete rehabilitation program. More specifically, patients can utilize this application as a communication channel with health professionals (by means of messages that are prompted in their PC screen), to schedule and personalize

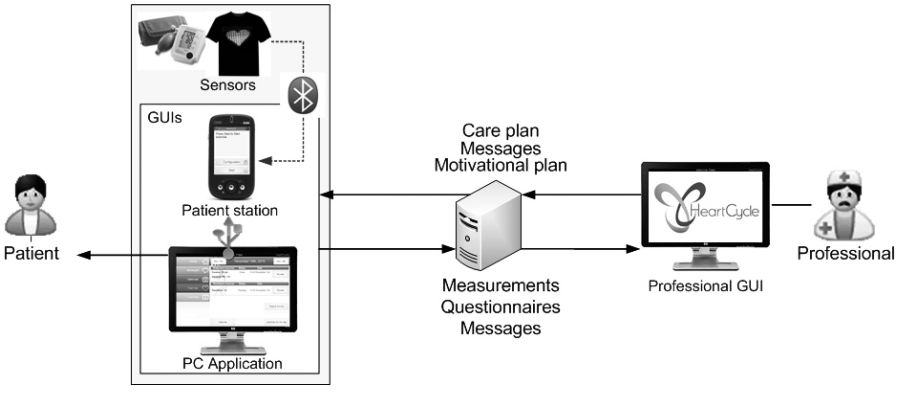

Fig. 1. Patient systems overview

their exercise sessions, and to receive feedback on the achieved progress. Additionally, the system will also motivate them towards their goal achievement, by presenting rewarding messages and providing them with personalized and appropriate educational content (Fig. 1).

During the exercise sessions, patients wear a specific sensor for collecting vital signs and a portable unit (PDA) that guides them during the different stages of the session. These devices continuously control the health status of the patients ensuring that they are always on the adequate and safe range levels while performing the prescribed exercise. Once an exercise session is finished, all the gathered information is transferred to the patient station and, afterwards, to the professional system, where the physicians can evaluate the performance and adjust the care plan, if needed.

3 Methodology

The patient system has been developed following the principles of User-Centered Design (UCD), aiming to guarantee its acceptance and usability. The methodological approach chosen has been Goal Oriented Design (G-OD) [4]. G-OD proposes an iterative approach that starts with a thorough research of the problem under study and continues with intermediate validations of increasingly complex prototypes with actual and potential users of the system (namely, with patients and health professionals during the development life cycle of the system) [5]. In the case of the patient system, the development started with the analysis of the specific use case aimed to reflect all patient's needs and goals, and the innovative features that should be provided. This study led to the identification of four main blocks of functionalities to be considered: (1) a care plan, with the prescribed exercise sessions, including details on frequency, duration and level of effort to achieve; (2) messages system, to establish a communication with the patient; (3) reminders of pending activities and feedback on the progress of the completed sessions; and (4) a complete motivation and education strategy focused on increasing the knowledge of patients about their disease and rehabilitation process, while incentivizing them to follow the exercise program.

The concept also included personalization features, a requirement of paramount importance in order to improve the user experience and to facilitate the patient's adherence to the system. Different ways of personalization have been considered in the interaction: personalization of educational content, personalization of feedback or form factor, and personalization based on knowledge or technical skills. Finally, a specific design of the graphical user interfaces for the envisaged system, including an attractive look and feel, was depicted.

Once the initial system design was finalized, a mock-up was built and validated with patients by means of interviews, using questionnaires that tackled motivation, usability and acceptability aspects. Questionnaires combined semantic differentials and Likert scales, used to gather quantitative data regarding usability and acceptability of the system, with open questions aimed to obtain qualitative data about the patients' insights with respect to motivational and acceptability issues [6]. Patients' interviews were conducted in two different countries (United Kingdom and Spain) and locations (Hull and East Yorkshire Hospitals NHS Trust Castle Hill

Hospital, and Hospital Clínico San Carlos Madrid), involving a total number of 33 patients, suffering either coronary artery disease or heart failure.

Each interview itself included three main parts with a total duration of 45 minutes. The first ten minutes were devoted to a general introduction of the purpose of the test, the signing of the informed consent, and to gather demographic data and general health status of the patients. Afterwards, patients were asked to answer several questions focused on general motivation factors, more specifically on physical exercise and rehabilitation, medication, and learning preferences. The interview then continued with the usability and acceptability parts. After a short introduction and demonstration of the application, patients were asked to use it and perform specific tasks. Finally, they filled in a questionnaire with their impressions, as well as a scoring sheet [7].

4 Results

The outcomes of the validation were quite positive. System acceptance questionnaires showed that most of the patients (81%) liked the system and considered they would use it frequently (81%). Also, the majority of them (85%) thought that the application would help them to control their health and would motivate them towards a healthier lifestyle (67%). Only 11% of interviewees believed that the system would invade their privacy, thought that it would make them feel neglected by their physician, or

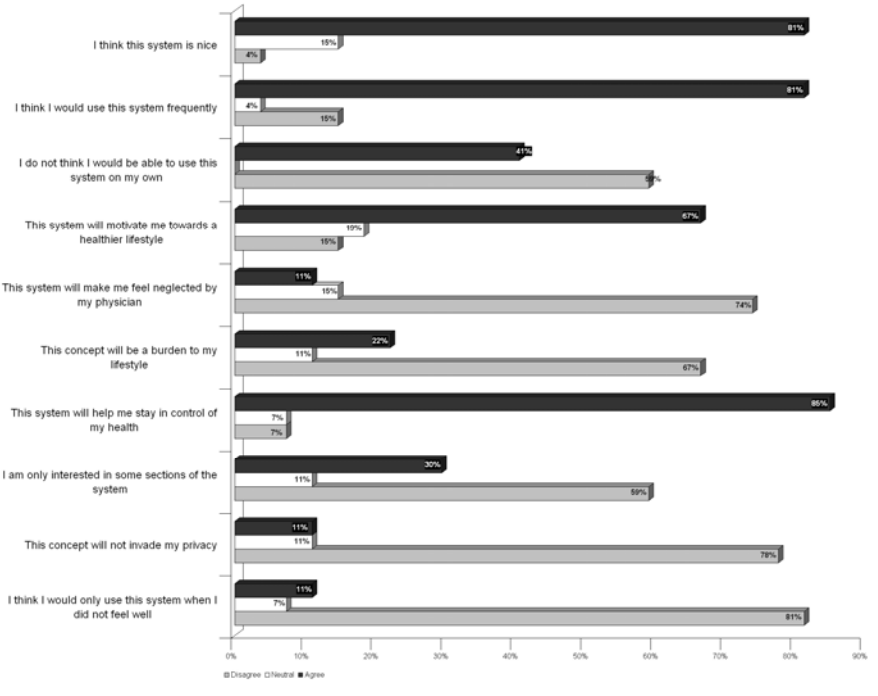

Fig. 2. Acceptance questionnaire results (27 Patients interviewed). Rating values from 1 (completely disagree) to 5 (completely agree). Results analysis disagree (1 or 2), neutral (3), agree (4 or 5)).

reported they would just use it when they would not feel well. Moreover, approximately one third of the patients (30%) would like to select the features to use of the application. On the other side, a considerable percentage of patients did not feel capable of using the system on their own (41%), the majority of them were advanced age users living in Hull (UK). In these cases, interviewers informally asked the patients about the reasons for this concern, which mainly resulted to be reluctance to use new technology because they were not familiar with it (Fig. 2).

Usability aspects of the system were also very well valued (Fig. 3). A great majority of patients perceived it as usable (76%) and stimulating (79%). The presented application was found very pleasant by 88% of the interviewees and also 88% of them rated it as not intimidating. Finally, the great majority of patients (94%) considered the system very interesting.

Although no major problems were identified in the interaction with the application, 12% of the interviewed patients rated usability aspects with low values, mainly due to their advanced age and their reluctance to use new technologies. In these cases, patients provided the interviewers with some suggestions and feedback that helped the designers to improve subsequent versions of the user interfaces (i.e. simplifying the contents of certain screens, adding supplementary pictures for better understanding the functionality, etc.)

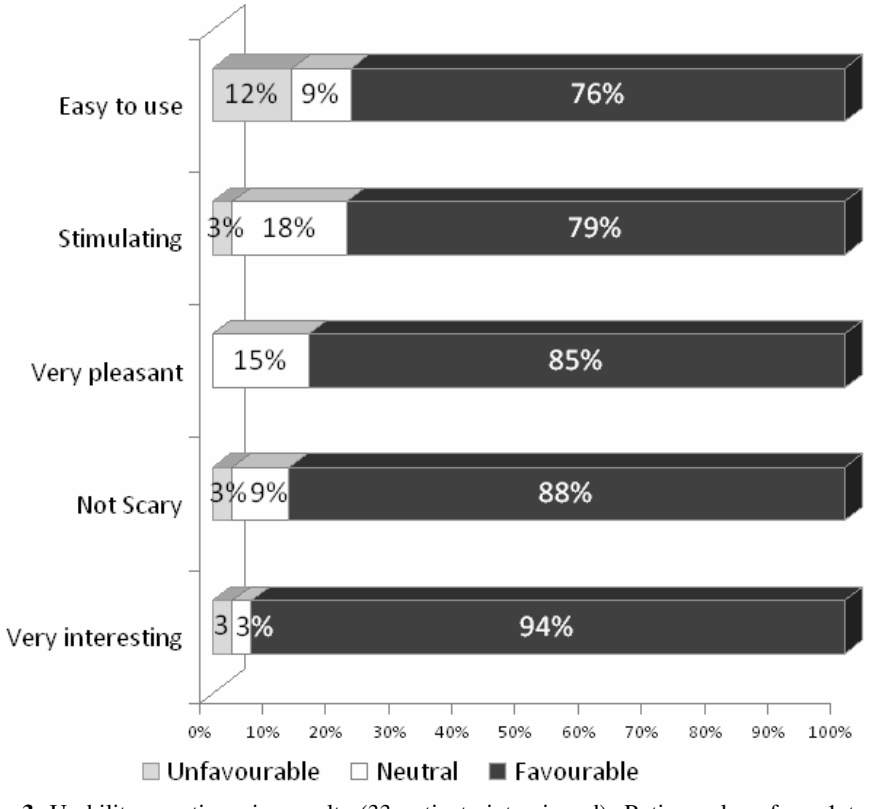

Fig. 3. Usability questionnaire results (33 patients interviewed): Rating values from 1 to 5. Results unfavorable (1 or 2), neutral (3), favorable (4 or 5).

The validation of the system also included an initial study on the possible education and motivation material to be included in the application. The results revealed differences between the patients' interests on the different topics and the need of introducing personalized education and motivation strategies and content in the system.

The outcomes of this validation led to a refinement of the global design and the implementation of an improved cardiac rehabilitations system. This new version has taken into consideration all the received suggestions and has specifically addressed the aspects that obtained worse rates in the conducted validation. Moreover, a new and more attractive look and feel has been included in the final development.

The complete system for cardiac rehabilitation is planned to be validated in a clinical trial during 2011, involving approximately 60 patients in 3 different locations (Spain, United Kingdom and Germany).

5 Conclusions

Although cardiac rehabilitation programs have proven to be really important for a complete recovery after suffering a heart attack, the lack of resources in the health care system and the need of continuous health professional supervision have usually hampered their introduction into the standard care. Nowadays, only a reduced number of post-MI patients can access this kind of programs, which are often offered in certain specialized health centers.

The presented system propose a personalized home based rehab program that constitutes an attractive alternative to the traditional ones, as well as represents an interesting solution for possibly extending cardiac rehabilitation to a higher number of potential patients. As it offers patients supervised care while they are following a program at home, it could be easily adopted and implemented within the health care system with a limited amount of extra resources.

The positive outcomes of the conducted validation tests, both in terms of usability and acceptance, have proved that the solution could be a feasible option to be incorporated into the normal health practice and have also set up very good perspectives for the adoption of this kind of systems in the future. It is expected that HeartCycle solution will highly benefit a great number of post MI patients in their recovery process.

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References

1. World Health Organization. Fact sheet N°317. updated (September 2009)
2. Hamm, L.F.: Core Competencies for Cardiac Rehabilitation/Secondary Prevention Professionals. Journal of Cardiopulmonary Rehabilitation and Prevention (2010) update, http://www.jcrpjournal.com (last access 4th February 2011)

3. Heart Cycle project, Compliance and effectiveness in HF and CHD closed loop management, European Commission, FP7 – ICT216695, http://heartcycle.eu/ (last access February 2011)
4. About Face 3.0 The Essentials of Interaction Design. Wiley Publishing, Inc., Chichester (2007); ISBN-10: 0470084111
5. MyHeart: Fighting cardiovascular diseases through prevention and early diagnosis. European Commission, FP6 – IST-507816, http://www.hitech-projects.com/euprojects/myheart/ (last access February 2011)
6. Tullis, T., Albert, B.: Measuring the user experience. Morgan Kauffmann, San Francisco (2008); ISBN: 9780123735584
7. Heart Cycle project, Deliverable 11.4 – Patient Loop Specifications and User Manuals, Annex of CAD Patients Confrontation Results (February 28, 2011)