

# Coaching Compliance: A Tool for Personalized e-Coaching in Cardiac Rehabilitation

Supraja Sankaran<sup>1</sup>(✉), Mieke Haesen<sup>1</sup>, Paul Dendale<sup>2,3</sup>, Kris Luyten<sup>1</sup>,  
and Karin Coninx<sup>1</sup>

<sup>1</sup> Expertise Centre for Digital Media,  
Hasselt University-tUL-imec, Diepenbeek, Belgium  
{supraja.sankaran, mieke.haesen, kris.luyten,  
karin.coninx}@uhasselt.be

<sup>2</sup> Faculty of Medicine and Life Sciences,  
Hasselt University, Diepenbeek, Belgium  
paul.dendale@uhasselt.be

<sup>3</sup> Department of Cardiology, Jessa Hospital, Hasselt, Belgium

**Abstract.** Patient coaching is integral to cardiac rehabilitation programs to help patients understand, cope better with their condition and become active participants in their care. The introduction of remote patient monitoring technologies and tele-monitoring solutions have proven to be effective and paved way for novel remote rehabilitation approaches. Nonetheless, these solutions focus largely on *monitoring* patients without a specific focus on *coaching* patients. Additionally, these systems lack personalization and a deeper understanding of individual patient needs. In our demonstration, we present a tool to personalize e-coaching based on individual patient risk factors, adherence rates and personal preferences of patients using a tele-rehabilitation solution. We developed the tool after conducting a workshop and multiple brainstorming sessions with various caregivers involved in coaching cardiac patients to connect their perspectives with patient needs. It was integrated into a comprehensive tele-rehabilitation application.

**Keywords:** Technology in healthcare (primary keyword) · HCI · Remote rehabilitation · Information recommendation · Personalized coaching

## 1 Introduction

A rehabilitation program is typically composed of various elements such as monitoring and managing physiological parameters, physical exercise, medication intake, adherence, diet and coaching. Technology-assisted remote rehabilitation programs eliminate the need to visit rehabilitation centers by monitoring performed rehabilitation activities in a home environment [1]. While these have been proven to be effective [2], most programs focus exclusively on activity and progress monitoring with no focus on coaching.

Patients suffering from chronic illness such as cardiovascular diseases often lack awareness and knowledge of their condition, resulting in low adherence and increased drop-out rates over time. This reaffirms the law of attrition [3] of e-health technologies. Given the evolution towards patient-centered care systems [4], especially in remote

rehabilitation programs, there is a pressing need to enable patients to play an active role in understanding and managing their own disease. Patient coaching potentially facilitates in creating this awareness and goes beyond educating patients by ‘coaching’ them towards healthier behavior and lifestyle changes. To bridge this gap between tele-monitoring, patient education and coaching, e-coaching approaches also need to go beyond merely educating patients by being integrated into comprehensive tele-monitoring solutions and by personalizing coaching based on patient needs.

In our demonstration, we present an approach and corresponding tools, for personalized e-coaching. The approach focuses on awareness and tailored information provisioning for rehabilitation in cardiac patients.

## 2 Design Process

We followed a systematic approach to define a process to optimally generate personalized coaching trajectories for different patients. The approach we followed comprised of four phases; grounding the tool based on expert opinions of a multidisciplinary medical team.

The first phase focused on *generating coaching content*. In our context, the e-coaching content essentially refers to a collection of video fragments that have been developed specifically to coach rehabilitating cardiac patients. Unlike other e-coaching approaches that use text messages or emails [5], videos are a closer replacement for face-to-face coaching to educate patients and equip them to cope better with their condition. For generating the most appropriate content to address patient-specific needs, we conducted a workshop with experts from different medical domains specialized in guiding rehabilitation and coaching patients.

The focus of the second phase was to analyze the content and *identify all the dependencies*. ‘Dependencies’ in this context refers to which risk factors relate to which content categories and what specific topics fit into a certain category. ‘Content categories’ refers to broad themes targeting rehabilitation such as importance of compliance, understanding disease, medication and side effects, returning to work and so on. ‘Risk factor tags’ are related to modifiable risk factors [6] associated with cardiac diseases such as managing cholesterol and blood pressure, regulating weight and sugar etc. This enabled us to classify content into clusters, map dependencies and connect associated risk factors to the right coaching context.

A default prioritization of the fragments was also made based on importance of certain video content for rehabilitation with support for further personalization based on patient-specific needs. Based on the categorization made by domain experts, we prioritized the topics when filtered using the ‘I♥Coaching’ tool. For example, if four experts mapped a topic T1 to a category C1 and only 2 of them mapped topic T2 to the same category, T1 is displayed before (i.e. higher) T2 in the filtered list. The fact that I♥Coaching uses a default prioritization derived from inputs of different domain experts and provides for further personalization, is one of the core strengths of our approach.

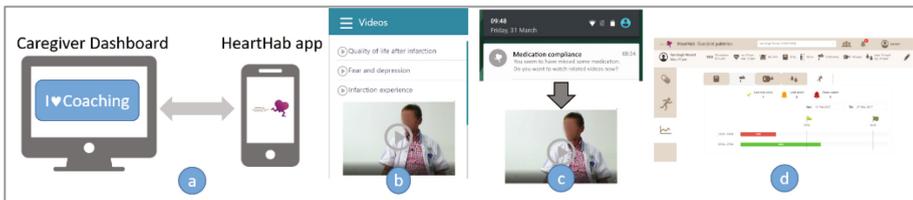
The next phase involved *translating analyzed content clusters and dependencies into an algorithm* that can autonomously filter the most appropriate content to be

shown to patients upon making specific selections. The selections were based on generic content themes, or more precisely, on patient-specific risk factors.

The final phase concerned the use of the developed algorithm to *generate a tailored patient-specific coaching trajectory* for each patient.

### 3 System Components

The overall system we demonstrate includes a dashboard application for caregivers, a mobile application for patients (HeartHab) [7] and an e-coaching recommendation tool (I♥Coaching) that is integrated in the dashboard application (Fig. 1a). While the dashboard and the HeartHab app include other components relevant to remote rehabilitation of cardiac patients, the primary focus of this work is on how the I♥Coaching tool facilitates caregivers in generating personalized coaching trajectories for patients to consume using their mobile application in a remote setting.



**Fig. 1.** (a) Components in the tele-monitoring solution with the ‘I♥Coaching tool’ as a part of the caregiver’s application. (b) Tailored list of coaching content presented in the HeartHab app. (c) Dynamically triggered content based on a monitored parameter. (d) Screenshot of the caregiver dashboard application used for monitoring patients’ progress.

By means of the caregiver dashboard (Fig. 1d), the caregivers initially configure a patient-specific trajectory using the I♥Coaching tool along with prescribing other rehabilitation goals, such as weekly exercise targets, daily medication prescriptions etc. These recommendations are translated into rehabilitation goals in the HeartHab app that records patient’s progress and activities. Based on the recommended personalized trajectory, the coaching video fragments are presented to the patient in that specific sequence via the application (Fig. 1b). Additionally, videos can also be triggered based on a parameter that is monitored by the application (for example, when medication compliance is low as shown in Fig. 1c).

#### 3.1 I♥Coaching Tool Walkthrough

I♥Coaching includes the core coaching data that is required for generation of personal recommendations: (1) a set of topics covered by the video fragments used for e-coaching, (2) a classification of the video fragments in health-related categories, and (3) an exhaustive set of tags based on various coronary risk factors and content categories. First, an extensive list of coaching fragment topics (Fig. 2a) can be selected by caregivers by

filtering on content categories or specific risk factor tags based on the personal profile of the patient and the importance of specific risk factors. Figure 2b shows an example of applying a filter based on the category ‘disease specific information’. Using the individual risk factors of a patient, the set can be filtered further to identify most relevant fragments for that specific patient (e.g. reduce sugar and control cholesterol). The caregiver can then modify the default prioritization if needed, as shown in Fig. 2c.



**Fig. 2.** (a) Screenshot of the I♥Coaching tool showing the list of video fragment topics. The tool enables caregivers to (b) filter topics based on categories or risk factors, and (c) modify prioritization by directly dragging and moving the topics in the list.

## 4 Conclusion

In the demonstration we present an approach and supporting tools that were designed and developed to personalize e-coaching with an aim to increase adherence of cardiac patients. The design of this approach was based on a series of brainstorming sessions, interviews and a workshop with domain experts and caregivers involved in coaching patients. The tools and approach we demonstrate support a way to provide individually tailored coaching content to patients instead of hardcoding a pre-defined algorithm in a tele-monitoring application. Since the approach integrates the perspectives of multiple specialists, it supports caregivers to reason on a conceptual level and strive for a uniform coaching practices.

## References

1. Jolly, K., Taylor, R., Lip, G., Stevens, A.: Home-based cardiac rehabilitation compared with centre-based rehabilitation and usual care: a systematic review and meta-analysis. *Int. J. Cardiol.* **111** (2005)
2. Hansen, D., Dendale, P., Raskin, A., et al.: Long-term effect of rehabilitation in coronary artery disease patients: randomized clinical trial of the impact of exercise volume. *Clin. Rehabil.* **24**, 319–327 (2010)
3. Eysenbach, G.: The law of attrition. *J. Med. Internet Res.* **7** (2005)
4. Krist, A.H., Woolf, S.H.: A Vision for Patient-Centered Health Information Systems
5. Vale, M.J., Jelinek, M.V., Best, J.D., et al.: Coaching patients On Achieving Cardiovascular Health (COACH). *Arch. Intern. Med.* **163**, 2775 (2003)

6. Cardiovascular disease risk factors | World Heart Federation, <http://www.world-heart-federation.org/press/fact-sheets/cardiovascular-disease-risk-factors/>
7. Sankaran, S., Frederix, I., Haesen, M., Dendale, P., Luyten, K., Coninx, K.: A grounded approach for applying behavior change techniques in mobile cardiac tele-rehabilitation. In: Proceedings of PETRA 2016, pp. 1–8 (2016). doi:[10.1145/2910674.2910680](https://doi.org/10.1145/2910674.2910680)