

MyAirCoach: Designing a mobile application for the education of patients regarding asthma disease

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Abstract—Digital health holds the promise to elevate many fundamental burdens from the traditional healthcare system through the utilization of modern technologies and the integration of a plethora of data resources. On one hand, mobile technologies are in the center of this transformation as they are forming the basis for the objective assessment of a variety of health parameters in the real life environment and for the increased and more effective involvement of patients in the healthcare process. On the other hand, chronic diseases in general and asthma in particular are expected to be drastically benefited from mobile technologies as they depend greatly on the adherence of patients to their prescribed treatment, and they require a continuous monitoring of health indicators. The MyAirCoach project is aiming to contribute in bridging this gap between the available technologies and the need for new asthma management approaches, through the development of novel solutions that will support patients and healthcare professionals. Efficient patient education is considered a fundamental component in this process as it holds the promise to positively affect all the above aspects of asthma self-management. In this direction the MyAirCoach mobile application was designed to include an education framework that aims to increase the awareness of patients about the disease of asthma and help them improve their technique of inhaler use through illustrative presentations and interactive multiple choice questions. The current paper outlines the development process and selected structure of this environment, and takes a first step towards its validation through the first round of feedback collected from the MyAirCoach Advisory Patient Forum.

Keywords—asthma; patient education; inhaler technique; self-management; mobile technology.

I. INTRODUCTION

Asthma is a chronic respiratory disease that affects more than 235 million people worldwide [1, 2], forming a significant socioeconomic burden in terms of direct healthcare costs and disability adjusted life years [3, 4]. The complexity and difficulty of effective asthma management is evident in the diversity of its prevalence around the world [5, 6] and the inability of even developed countries in North America and Europe to help asthma patients in the optimum manner [7, 8]. This difficulty in asthma treatment, can be partially attributed to its multi-parametric nature than includes psychological in addition to physiological and environmental parameters, creating a complex network of dependencies that cannot be easily outlined and effectively addressed [9, 10].

Two of the most important and well-studied aspects of asthma management are the agreement of patients' behavior with the prescribed action plan (adherence) and the correct use of the inhaled medication devices (competence) [11-15]. Reduced adherence and competence have been associated with significant worsening of the disease [16, 17], with 24% of asthma attacks and 60% of asthma related hospitalizations being attributed to suboptimal use of medication [18]. Nevertheless, a significant percentage of patients do not know how to correctly use inhaler devices [19, 20], a characteristic that is also projected to the medical community [21, 22].

All the above underline the importance of novel methodologies for the strengthening of patient involvement in the healthcare environment, and stress the need for continuous and effective education regarding the fundamental aspects of asthma disease and treatment [23]. Unfortunately, the education of patients and healthcare professionals through the traditional approaches requires significant amounts of time and effort from both trainers and trainees [24, 25], a fact that has led to the adoption of digital learning approaches using computer and internet based platforms [26, 27].

II. MOBILE HEALTH APPLICATIONS FOR ASTHMA

Health oriented mobile applications have significantly evolved during the last years, and are gradually addressing important issues of health problems including the disease of asthma. In this content, two recent review studies have focused on this continuously evolving ecosystem of asthma oriented mobile applications, and mapped some of their most important characteristics [28, 29]. More specifically, all the reviewed asthma apps were separated in four major categories based on their functionalities, namely: a) education oriented applications (teaching, training), b) applications offering self-management tools (tracking and visualization of medical and environmental information), c) applications with socialization and doctor-patient communication capabilities and finally, d) applications directed to healthcare professionals.

Regarding the education oriented applications, and despite the fact that this category covers half of the reviewed apps (52% and 56% respectively), all of them utilize static text or video approaches without any interactive or gamification components. Furthermore, 20% of the applications offer information regarding alternative treatments such as yoga and home remedies, whereas only 9% of them explain clinically validated treatments and the importance of adherence to the

action plan prescribed by doctors [28]. Finally, both reviews underline the reduced number of applications that provide instructions for the proper user of inhalers, 9% and 8% of reviewed apps respectively.

It is therefore evident how important is to form a basis for the development of novel mHealth solutions which are easy and intuitive to use and which are strongly connected with the prescriptions of health care professionals. Furthermore, efforts should be made to coordinate quality assurance processes that will support practices based on medical knowledge as opposed to attempts to promote invalidated interventions that may risk the wellbeing of their users.

III. THE HEALTH BELIEF MODEL

In order to formulate and structure the design processes of the MyAirCoach mobile app the Health Belief Model (HBM) was adopted. HBM is one of the most widely used conceptual frameworks in health behavior research [30] and has been chosen as the best fitted for the design of the myAirCoach educational components. The HBM is structured around six fundamental concepts that can be used to describe the changes in health behavior and also guide the design of health behavior interventions, namely: susceptibility and severity, benefits and barriers, actions and self-efficacy. Although for the case of asthma patients the perceived susceptibility of the actual disease is irrelevant, the perceived susceptibility of asthma attacks is a fundamental component of the perceived asthma severity. Perceived benefits and barriers are two other HBM concepts that encapsulate the patient's beliefs regarding the effectiveness and possible costs of the advised asthma action plan. Finally, the cues for action form the strategy to activate readiness and adherence, whereas self-efficacy describes the confidence of the patients in their ability of take action and effectively support the management of their disease.

IV. THE MYAIRCOACH MOBILE APPLICATION

The MyAirCoach mobile application was designed to accommodate the sensing and decision support functionalities of the project and therefore is password protected in order to guarantee the privacy of medical information within the framework of confidentiality between doctors and patients (Fig. 1a). The mobile application is based around three main pillar functionalities namely: the electronic health record (myHealth), the online virtual community (mySupport) and the interactive education and training approaches (myEducation).

The first group of functionalities (myHealth) is designed to allow patients to assess their medical record, manage their action plan in coordination with the responsible health care professional and receive automated and personalized notifications that can help them follow their prescribed treatment and improve their asthma condition. This section will also be responsible for the intuitive visualization of important health parameters for their easy supervision and understanding by the patient.

The second group of functionalities (mySupport) is directly connected with the communication capabilities that will be offered within the MyAirCoach privacy preserving framework. Patients using these tools will be able to communicate directly through the app with their doctors and family and share

comments regarding their health history and record. Furthermore, an anonymized community platform will allow patients to share their experience and help others facing similar difficulties under the supervision of their doctors in order to minimize the possibility of spreading false or misleading information.

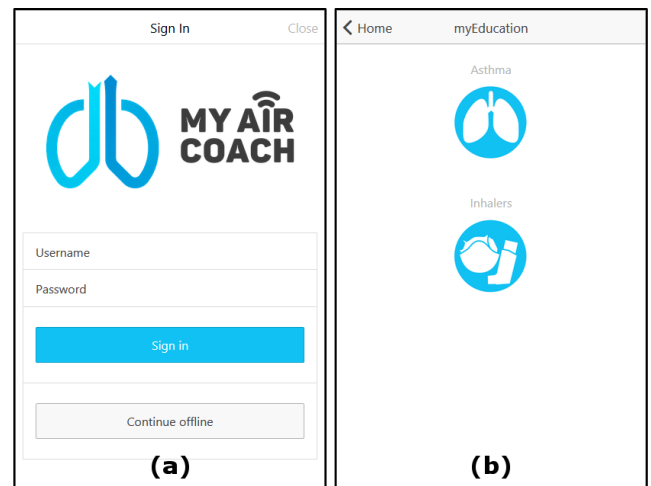


Fig. 1. Sign in screen (a) and education submenu (b) of the MyAirCoach mobile application

The third group of functionalities (myEducation) is designed to cover all the educational aspects that are related with the effective management of asthma and is separated in two main categories (Fig. 1b), namely: a) the education of patients regarding the pathophysiology, causes and symptoms of asthma disease and b) the training of patients for the proper use of different types of inhalers in accordance with the prescribed action plans.

The education of patients regarding their disease is based on the interactive presentation of concise and informative slides (Fig. 2a) that summarize the most important aspects of asthma pathophysiology and treatment in order to allow patients to understand the reasons behind every component of their medication plan. These educational components are aiming to contribute to the increased perception of patients as defined in the HBM, through the presentation of risks and common exacerbation triggers. Furthermore, the perception of treatment benefits and barriers of the HBM will be also supported by the myAirCoach educational components. In detail, the presentation of actions to take in cases of risk and in order to avoid areas with high concentration of irritants, will be always paired with the description of the positive effects of these strategies and the explanation of the foreseen improvements in the patient's quality of life. This strategy is also expected to contribute significantly to the elevation of important psychological barriers that usually prohibit patients to consistently follow their medication prescription.

The training of patients for the proper use of inhaler devices is based the illustrated instructions and self-testing approaches that will allow a more interactive educational approach. Different instruction sets are offered for the most common types on inhalers (Fig. 2b), including pressurized Metered Dose Inhalers (pMDI), and two types of Dry Powder Inhalers

(DPI), namely Diskus and Turbohaler. Furthermore, the education for the use of spacers is separated from plain pMDI in order to allow a more detailed and directed methodology. Finally, in order to allow the self-testing of patients' knowledge and underline possible misconceptions of inhaler technique, a set of interactive questions are giving to the patients the opportunity to check their knowledge and determine possible steps of their technique that are not correct (Fig. 3). The above described training components are aiming to support the self-efficacy of patients and activate their readiness, both of which are corner stone components of the HBM framework.

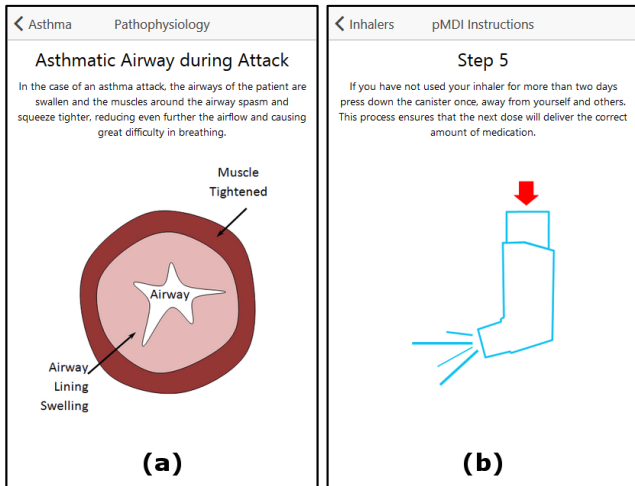


Fig. 2. Indicative slides for the education of asthma disease (a), and pMDI use instructions (b)

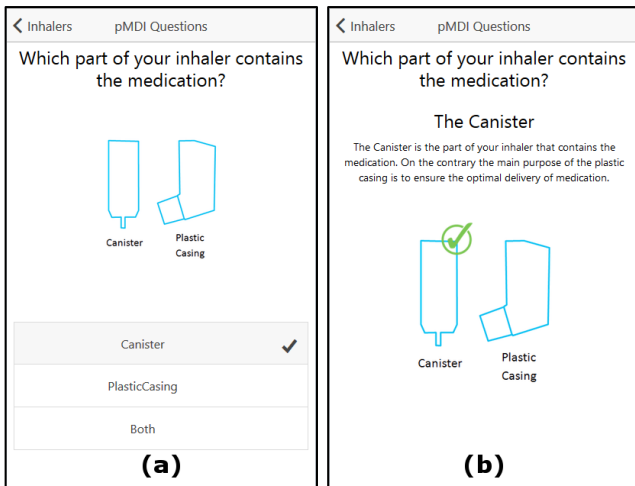


Fig. 3. Example of testing question (a) and respective answer (b)

The MyAirCoach mobile application was developed by using on the Ionic framework [31]. Ionic is a free open source framework for the development of multiplatform mobile applications with an extensive library of HTML, CSS and JS components. This option was selected in order to facilitate the integration of the final application with different operating systems including Android, iOS and Windows without the need for separate development for each one. Furthermore, Ionic offers core functionalities and interfaces in a unified solution

that can access the majority of mobile phone resources through the addition of specialized Cordova plugins [32].

V. FIRST ROUND OF FEEDBACK BY PATIENTS

The MyAirCoach project is following a User Centered Design (UCD) approach for the development of all the components of the system, including the current mobile application. In this direction an Advisory Patient Forum (APF) was constituted in the first months of the project in order to allow the direct connection of the project's outcomes with the actual needs and requirements of patients. In the framework of this process, and as a first step for the validation of pMDI inhaler instructions, the members of APF were asked to comments and provide their suggestions. Most of the patients provided positive feedback and useful suggestions for the best use of pMDI based on their long experience with inhalers and helped for the definition of instructions that are concise and easy to use, but maintain their informational content and do not exclude any steps of proper inhaler technique.

VI. CONCLUSIONS

Asthma is one of the most common chronic diseases, posing a significant burden on the life of patients and the healthcare system as a whole. Unfortunately, the education of asthma patients regarding their disease and medication hasn't yet received adequate attention by the clinical and technology community, leading to the reduced representation of asthma education in the environment of mobile applications.

In this study, we present a short overview of the MyAirCoach mobile application which is aiming towards the optimization asthma treatment and the increased involvement of patients in the healthcare process with special focus on the developed educational components. The HBM was used as the main conceptual framework for the design of the proposed educational intervention and is also intended to be the basis for the interpretation of its results and optimization in the following stages of the MyAirCoach project. Furthermore, and in order to establish a connection between the design and development of the application with the actual needs of patients, the Advisory Patient Forum of the MyAirCoach project was involved in the development process shortly after its assembly. Finally, health care professionals within the consortium have helped form the initial validation of inhaler instructions and provided crucial feedback from the doctor's point of view. The results from this first round of UCD have underlined not only the usefulness of the proposed framework, but also some important misconceptions within the patient community in regards to the proper use of MDIs.

VII. FUTURE WORK

The next steps of the current research are to continue the evaluation process of asthma education and inhaler instructions and extend them to the majority of commonly used inhalers. Furthermore, system evaluation processes should be redefined and based on objective and validated questionnaires that will provide a more accurate view of the results of myAirCoach educational components on the health and lifestyle of asthma patients and on the basis of previous bibliography [33]. Finally, and as the educational components of the MyAirCoach mobile

application are starting to form a complete and unified instructions manual and asthma education material, their evaluation by health care professionals outside the project's consortium should be performed. The success of the above steps before the publication of the application and its availability for download by the asthma patient community will guarantee not only the optimum health outcomes but also protect the users from any unintended consequences.

In the following stages of the project and in addition to the education and training functionalities the MyAirCoach mobile application will be enhanced with decision support tools and personalized modelling components that will allow patients to better manage their disease. Furthermore, the MyAirCoach system will be enhanced with a privacy protected communication platform that will allow patients to communicate their condition with their families and doctors. Finally, the MyAirCoach system will support clinicians and help them to supervise the condition of their patients in an efficient and effective manner and modify their prescribed medication regimens accordingly.

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