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DPO₂ Project: telehealth to enhance the social role of physical activity in people living with COPD

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Abstract

Telehealth has been referred as an innovative solution for COPD patient treatment, minimizing the costs related with medical assistance while improving the patient care support and health outcomes. We have designed an innovative telehealth program of pulmonary rehabilitation (PR) that aims to increase long term adherence of patient to physical activity (PA), self-care management of health condition and facilitation of social participation following an approach of community-based intervention, taking account the patient preferences. Therefore, our telehealth program combine education sessions, exercise training and follow up of health outcomes using a mobile application and a wrist oximeter, through bluetooth technology, for facilitating outdoor exercise and social participation of people living with COPD.

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1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a disabling respiratory disease that has increased over the last years and actually represents the third leading cause of death in the world (1). Dyspnea, cough and sputum production are frequent and highly decrease quality of life and social participation. (2) The growing prevalence of COPD leads to an increasing of costs, mainly healthcare-related which include consultations, hospitalizations, home care rehabilitation and medication (3). Exacerbation of symptoms lead to frequent hospitalizations which accounted for the majority of the COPD healthcare related costs (3).

Telehealth has been referred has an innovative solution for COPD patient treatment that minimize the healthcare-related costs while improves patient care support and health outcomes. However, there are some limitations regarding social interaction of people living with COPD. In this article, we pretend to present a new community-based telehealth approach. First, in section 2, we give an overview of care strategies for COPD patients and telehealth options, including other solutions available in the market, in section 3 we describe DPO₂ project and design a solution for addressing the needs of people with rehabilitation needs.

2-Overview

Pulmonary rehabilitation (PR) programs have been recommended to optimize physical and social performance and promote the autonomy of people (2). Although strategies recommended for COPD patients include smoking cessation, optimization of pharmacotherapy, early identification and assistance of acute exacerbations, optimization of nutrition (2), PR is an essential component for management of COPD condition, decreasing frequency of exacerbation, disability, depression and social isolation and is associated with lower mortality rate (4, 5).

COPD guidelines refer to PR as an interdisciplinary program of care focused on strength and endurance training and educational sessions (2,4,6). The recommendations set a minimum of six to eight weeks, with two to three sessions per week, to achieve improvements in exercise performance and quality of life (6). It seems that longer programs produce greater benefits. Therefore, continuation of positive exercise behavior should be supported with home or community-based programs (5).

Benefits of PR are well established at system level (reduction of hospitalization and unscheduled healthcare visits) as well as patient level (improvement of clinical and functional outcomes, enhanced collaborative self-management, wellbeing and self-efficacy) (7,8). However, it's estimated that only a few parts the population with COPD have access to these programs (9) and patient's adherence is limited to practical issues such as finances, transportation and psychosocial support (10). For another way, people attend a PR program if it's home-based and adapted to their preferences and lifestyle, making them feel self-confident (10)

Telehealth is a new clinical trend involving the delivery of components of the multidisciplinary tailored intervention that can combine telemonitoring, teleconsultation, tele-education and telerehabilitation (11). It also enables health professionals to remotely engage and deliver patient care outside of the medical setting and minimize the distance issue between clinician and patient while increasing self-efficacy of the patients in management of their health condition (12).

Teleconsultation and tele-education involve forms of video conferencing or software to access patients or to delivery education. Telemonitoring includes technology within patient's homes that permit to evaluate patients including chest auscultation, vital signs, pulse oximetry and functional capabilities tests, real time or retrospectively transmitted to the health care team at a central location. Telemonitoring is very useful to prevent and to detect early exacerbations of COPD, as well as to monitor the response to exercise and to modulate PR programs intensity according with patient response. Tele-rehabilitation involves clinical assessment and treatment at distance using telecommunication devices. The efficacy of tele-rehabilitation depends on: provision of adequate equipment; supervision on the appropriate use of devices; regularly controls of the PA and health status of the patient (6).

There are a few solutions for home rehabilitation already, however, we found some limitations that can compromise social life of people living with COPD. Most of the existing solutions are focused on indoor exercises, using videos and images and, perhaps, scheduled evaluations, not considering other living environments of the patient.

According to Catenazzi *et al* (14), there are four top APP in the market that are directly related to Telerehabilitation and none of the APP's has in mind the social interaction of the patients. The following table describes the main features of the existing apps (14):





















Available Apps				
Features	PT Pal	PhysioTrack	MyPhysio App	Physioadvisor
Virtual Home Exercise				
Exercise Reminder				
Clinic Appointment reminder				
Message Future for Patient				
Tracking patient progress				

Figure 1: Comparison of features of available apps in the market

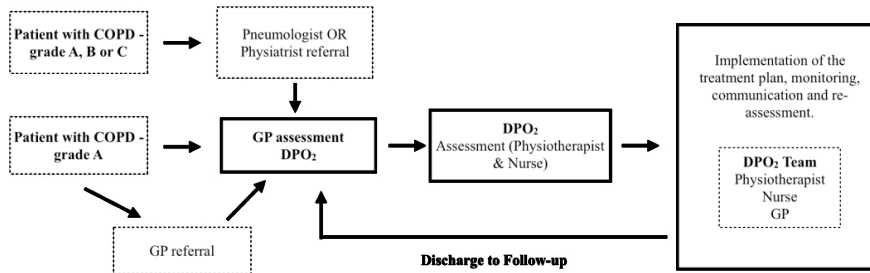
3- Telehealth solutions for rehabilitation of COPD patients

3.1. DPO₂ Project- characterization

DPO₂ program was designed based on principles of patient-centered care, integrated and personalized care as well as promotion of PA, self-care management and community inclusion enhancing access to care through telehealth. DPO₂ will include tele-rehabilitation with tele-monitoring, that aim to provide a tailored to patients with COPD, focused on education and exercise training according with patient preferences, enhancing the social role of PA and promoting long-term adherence to exercise. Patients included in DPO₂ program will use a smartphone application, which will guide them and allow communication with DPO₂ team.

Inclusion criteria:

People diagnosed with COPD - grades A, B and C GOLD, that have autonomous walking, cognitive ability to handle telemonitoring devices; ambulation device if prescribed long-term oxygen therapy and no contraindications for exercise, namely as described by Bayles et. al (2018) (13). Referral pathway to include patients in DPO₂ Program is described in Figure 2.

Figure 2: DPO₂ referral and care pathway

Patient assessment:

Multidisciplinary clinical assessment will be held by DPO₂ Team. For every patient included in the program will be applied 6min-walk test to assess functional capacity, muscle strength regarding one-repetition maximum (1RM), impact of COPD symptoms in health status with Modified British Medical Research Council (mBMRC) and COPD Assessment Test (CAT). Other data such as management capacity of non-invasive ventilation or oxygen therapy equipment; previous PA level, preferences and motivations for exercise, comorbidities, pharmacotherapy and its management as well as the assessment of risk behaviors (alcohol, tobacco and nutrition) will be undertaken.

Clinical Intervention:

The intervention will be divided in three phases: education sessions, exercise plan and follow-up as described in table 1. Education will focus on equipment use, pharmacologic management, self-management of dyspnea and vital signs during exercise, energy conservation strategies; management of bronchial secretions, healthy living behaviors, smoking cessation if necessary, education about the disease, motivation for adherence and compliance with the plan, definition of objectives. This will be held by the nurse and the physiotherapist. In the second phase, the physiotherapist will prescribe the exercise plan according with patients' preferences and shared decision making with the team considering the services available in the community and based on current recommendations for prescription of aerobic exercise and strength training in association, as summarized in table 2. (13).

Table 1: Intervention phases for COPD patients

Referral	Assessment With DPO ₂ Team	Phase I Home Visits (1-3) visits	Phase II Exercise Plan and Telemonitorization (12-24 weeks)	Phase III Follow-up in each 6-months
Pulmonologist or Physiatrist Hospital Center	GP Medical assessment for inclusion in DPO ₂ and follows up of patient condition;	-Equipment Installation -Education and self-management strategies training	Implementation of the exercise plan -App and devices to measure vital signs. Telemonitoring: During exercise: oxygen saturation and heart rate Before and After exercise: blood pressure, mBorg	Discharge from 2nd phase if: -Integration and adaptation of exercise in daily life -Exercise with safety -Achieve minimal clinically differences in 6-MWT (>36).
	Physiotherapist Functional Capacity Assessment	-Exercise plan definition considering the patient context and preferences & promoting the inclusion in the community	DPO ₂ Team Retrospectively analyse the exercise plan performance according with data measured. On call for urgent contacts during daytime.	6-month appointment: -Re-assessment; -Reinforce motivation and adherence to exercise -Problem-solving.
GP Primary Care Center	Nurse General Health Status assessment and medication management		Re-assessment: each 6 weeks by phone call.	

Table 2. Summary of the American College of Sports Medicine recommendations for aerobic and strength training for patients with COPD

Aerobic Training	Strength Training
3-5x/week for 12-24 weeks	Multi or single joint exercises focused on low and upper limbs;
20-60 min duration	Rest periods of at least 48-hours.
mBorg: 4-6	40-50% one-repetition maximum
Exercises included: walking outside or on a treadmill, bicycle (static or not), ergometer of upper limbs, group classes in the community or adapted gym classes.	Exercise equipment and/or body weight.

Monitoring:

Through the mobile app it will be possible to obtain real-time feedback on peripheral oxygenation and heart rate measured with a wrist oximeter, through Bluetooth technology. Before and after exercise patient will be instructed to measure blood pressure monitor and to rate the level of fatigue, using the Modified Borg Scale (mBorg), as described in table 1. During exercise, the patient will be notified whenever values of heart rate and oxygen saturation are outside of values settled. The app will record these data and sent them to a central database, where the DPO₂ team will analyze it retrospectively.

The team will be on call during daytime, in primary care center, in case of uncontrolled or changes in disease symptoms and for any equipment malfunction. During nighttime and in case of acute signs of exacerbation patients will have an option called panic button to ask for help.

The application will record also the adherence to the plan. If low adherence is recorded (skip 3 or more session in two weeks), the team will call or visit (if needed) the patient to explore the reasons, adapt the plan and objectives if needed.

Follow-up and re-assessment:

After each six weeks a phone-consultation will be made to adapt the plan or to discharge. Criteria to discharge 2nd phase to the 3rd phase and their components are described in table 1.

3.2 Designing a solution for addressing the needs of people with rehabilitation needs

In DPO₂ project, we're trying to reach all the needs and aims of a very special population when dealing with rehabilitation. In our view, the respiratory chronic disease population is very fragile and demands high level of care, not only in acute episodes but also during their normal life as well. As DPO₂ development team, we believe that our APP could reach a high level of requirements, addressing the disease in a totally unique way, helping to develop an internal sense of responsibility for the patient in the management of health condition and his personal life.

DPO₂ Project presents an innovative solution for COPD rehabilitation thinking in the social interaction, fighting social isolation due to COPD symptoms. Our main objective is to help chronic patients live well in the community, making their lives more independent and functional, shaking isolation and rejection. With DPO₂ App the patient can do all the rehabilitation process from different contexts (home, town park, gym, and others) allowing to participate in different social activities.

Beyond having all the presented features already used in the market (figure 1) DPO₂ has an additional one, tracking outdoor activity. The outdoor activity can be walking, power walking, zumba, elderly gymnastics, giving freedom of choice to the patient, abandoning the line of COPD rehabilitation exercises and routines.

The DPO₂ project uses peripheral devices, such as peripheral saturation, GPS tracker (smartwatch) and sphygmomanometer. Many of the market solutions have problems with Bluetooth technology. On the other hand DPO₂ project uses a Home HUB, delivering all the data from the patients' home and maintaining the peripheral devices synced and working along to make possible that patients follow their performance timeline, so that they can have an active involvement in their own rehabilitation.

As a first approach, we are planning to develop a simple APP, available for iPhone and Android, reaching all users. The APP will be user friendly, offering a perfect interaction between the patient/user, reducing the APP interface to the minimum possible, so that the operator/patient doesn't need to be an expert in technology.

Table 3. Features of DPO₂ app

APP specifications	Personal	Generic
Android User	Periodic scheduled videocalls	FAQ's including visual and audio guide
iPhone User	Extra videocalls in case of need by setting a urgent appointment with the professional	Advice on respiratory chronic disease & advise about seeking medical care
Access to Camera, Microphone, Location, Contacts	Appointment alarms	Recommended and established exercise programs (with demonstrative photos)
Live Streaming	Tracking patient progress by counting exercising time, amount of exercises completed and using effort scales	Exercises - log
Compatible with smartwatches	Patient tracking for outdoor activity counting moving time, distance traveled and effort scales.	Exercises - scheduled
	Tracking for outdoor activity could be recorded for following exercises	Exercises alarms and reminders

DPO₂ team is committed to keep their patients safe. Users have a panic button, contacting this way their relatives or the local authorities when they feel unwell while using the DPO₂ devices. In the same device, we can detect falls (DPO₂ encourages outside activity), using an accelerometer and a gyroscope. In this case, the alarm is automatic.

We will conduct usability testing using representative users to evaluate user-centered interaction and enable adjustments of DPO₂ APP.

5. Conclusion

In this work we have designed an innovative community-based telehealth solution for improving quality of health of people living with COPD, enhancing long term adherence to PA in a safe and autonomous way. We present a new telehealth approach of PR based on outdoor activities and considering patient preferences. Further work with potential users of the ICT solution will take place during the pilot. We expect that this new solution contributes for an efficient care, with reduced healthcare costs and effective patient care.

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