

Pulmonary rehabilitation, Timing, Location and Duration

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Abstract

Pulmonary rehabilitation programs vary widely across the globe in terms of duration and location. In addition variability exists in the patients that are judged eligible for rehabilitation. We review the options clinicians have to organize programs in terms of who should be referred, when, where and for how long. Interestingly, although programs have been compared regarding the mean effects studies using personalized programs in terms of duration and location are not yet done. There are several risk factors for lack of uptake and non-adherence to programs and logistical aspects (transportation) seem to be an important barrier. In terms of timing, patients suffering from muscle dysfunction are likely the best candidates for exercise training. There is no doubt that patients with exercise induced symptoms and those after exacerbations should be referred. Programs can be organized in several locations, each with advantages and barriers. When programs are adequately supervised there is no preference at group level for any of these locations. Patient preference should perhaps be used more as a criterion to prescribe a specific type of rehabilitation.

Introduction

This volume of Clinics in Chest Medicine elaborates in great length on the benefits of pulmonary rehabilitation. The effects of following a rehabilitation program cannot be stressed enough. Patients typically experience benefits in exercise capacity, functional performance, symptoms, disease mastery and health related quality of life. Promising, although less consistent, results are observed in increased physical activity levels of COPD patients^{1,2}. The mechanisms underlying these improvements across multiple outcome areas are undoubtedly multifold³ and are complementary to the mechanisms through which pharmacotherapy enhances lung function and patient centered outcomes. As a consequence, pharmacotherapy and pulmonary rehabilitation exert additive or even synergistic effects.

The improvements in outcomes realized by rehabilitation can be categorized by the World Health Organization (WHO) model into areas of bodily function, activity and participation. Not only do the interventions and beneficial effects differ considerably among various pulmonary rehabilitation programs, but the importance that individual patients attribute to a particular improvement also varies considerably. Ideally, the content of a program should be tailored to maximize the chances that patient's individual goals *and* the therapeutic goals of the rehabilitation interdisciplinary team

should be met. Both patient-individual and team goals are based on a comprehensive baseline assessment at the beginning of pulmonary rehabilitation. ⁴

In this chapter three practical and intimately related questions will be discussed: 1) who should be referred for pulmonary rehabilitation? 2) where should rehabilitation take place? and 3) how long should rehabilitation last? Across the globe there is a very large heterogeneity in these organizational components of rehabilitation⁵. Although seemingly simple there is no straight forward and fully evidence based answer available to these questions. Rather, for each several options are available. Ideally, based on the phenotype of an individual patient the rehabilitation team, referral to a particular program should best suit the patient. However, decisions in 'real life' are often influenced by limited availability of programs and limited reimbursement options.

Who should be referred?

Most research on the effects of pulmonary rehabilitation is carried out in patients known to respiratory specialists and studies have consistently shown wide variability in outcomes of rehabilitation in virtually all outcome measures studied. Only a handful of studies have attempted to identify the best 'responders' to rehabilitation programs. All these studies have defined responders in a particular dimension of outcome, and being a responder in that particular dimension does not imply automatically imply being a responder on other dimensions. As rehabilitation requires substantial effort and investment on both the patient and the rehabilitation team, the targeted outcome or outcomes of the program need to be identified and there should be reasonable expectation that the particular patient can significantly improve in these outcomes. Adherence with programs is crucial to result in benefits, ⁶ and several factors have been (weakly) associated with non-adherence to pulmonary rehabilitation. These include: lower levels of social support⁷; active smoking⁷⁻⁹; extremes of age^{8,9}; long-term oxygen use⁸; FEV1⁸; a lower health-related quality of life score^{8,9}; and longer travelling distance to the rehabilitation center. ⁸ A systematic review on the topic identified travel and transport issues and a lack of perceived benefit as barriers to both uptake and completion of programs. The only demographic features that consistently predicted non-completion were being a current smoker and depression¹⁰. Apart from these quantifiable factors there are a number of personal and system factors that influence uptake and adherence. Qualitative studies identified the service is introduced and the capacity of the service to meet the patient's life style needs are determinants of the willingness of patients to undertake the treatment. Themes that came up as determining the decision not to start rehabilitation or to interrupt a program were: difficulties with accessing the program (geography and timing); difficulties in prioritizing the treatment; contrary beliefs about the role and safety of exercise and fears about criticism (not to be

able to cope with exercise, or smoking status). These factors are only seldom recognized when the lack of uptake of rehabilitation is discussed. Obviously, a patient who does not start a rehabilitation program cannot become a responder.

A handful of studies have attempted to identify the best responders to exercise training. Prediction models are generally poor, but may give insight into the benefits that can be expected in individual patients. Patients with poor functional exercise capacity, more muscle dysfunction^{11;12} and better preserved ventilatory capacity¹³ seem to respond slightly better to exercise training. Two studies found that patients suffering from skeletal muscle fatigue after exercise¹⁴ or an exercise training program¹⁵ are more likely to experience physiological benefits of a training program. Thus, those patients with poor skeletal muscle function at the beginning of pulmonary rehabilitation are more likely to benefit from the exercise stimulus. Although one study suggested that younger patients are more likely to respond favorably to exercise training¹⁶, age is generally not seen as an important discriminator between responders and non-responders¹⁷⁻¹⁹. Similarly gender and lung function do not predict success of rehabilitation.

Typically, responders are defined in just one dimension, such as exercise capacity or quality of life. However, as depicted in Figure 1, improvement in one outcome area, such as exercise capacity is not necessarily related to improvement in another area, such as quality of life. Furthermore, for most end points, benefits can only be expected if there is a baseline abnormality. This is surely the case for less conventional end points, such as maintenance of postural control and balance or psychological abnormalities: benefits can only be attained if deficiencies in these dimensions are present at baseline. This again reiterates the importance of comprehensive baseline screening and the identification of patient specific goals for the rehabilitation program.

For people outside of pulmonary rehabilitation (chest physicians, internal medicine, or general practitioners), there is no very clear guidance on whom should be referred for pulmonary rehabilitation. The most recent Global Initiative for Obstructive Lung Disease (GOLD) strategy document advocates pulmonary rehabilitation as of GOLD Category 'B' which means that virtually any symptomatic patient with COPD should be considered for this intervention²⁰. A pragmatic approach might be to refer any patient with persistent respiratory symptoms (dyspnea, fatigue) and/or functional status limitations despite otherwise optimal therapy⁴. The British Thoracic Society guidelines give somewhat more practical guidance as to who should be referred to rehabilitation, based on the Medical Research Council (MRC) dyspnea scale of the patients²¹ (table 1).

Complementing these general recommendations, some patients in whom rehabilitation should be prescribed without hesitation. These include: 1) Patients with COPD who were recently admitted to

the hospital with an acute exacerbation; they should be offered a plan for rehabilitation by the time they get discharged. In these patients rehabilitation could be initiated during the hospital admission (see inpatient rehabilitation, below). The rehabilitation intervention in this setting also stresses self management training in order to prevent subsequent hospital admissions^{22;23}. 2) Patients with MRC dyspnea ratings of 3 or greater (i.e., walks slower than most people on the level) in whom all pharmacological options have exhausted. According to the British Thoracic Society recommendations they should be referred to pulmonary rehabilitation regardless of their lung function impairment. It should be acknowledged, however, that patients with lower MRC dyspnea (*I get short of breath when hurrying or walking up a slight hill*) may also stand to benefit from pulmonary rehabilitation in terms of exercise capacity, symptoms of anxiety and depression and symptoms of dyspnea^{24;25}.

It is very likely that, in the future, physical activity assessment may become an important criterion to select patients for pulmonary rehabilitation. Indeed, rehabilitation should be geared to re-activate patients with low physical activity levels, since low function in this area is an important factor in the systemic consequences of COPD, which are amenable to pulmonary rehabilitation. It may be that if a patient with severe lung function or exercise impairment is still relatively active, it is questionable that rehabilitation will lead to major benefits in this individual. However, although this reasoning appears intuitive, it still needs prospective validation. Valid activity monitors with patient- and investigator-friendly user interfaces have recently become available;²⁶ in the future these tools will likely become important in the selection of appropriate candidates.

Besides identifying the best possible candidates for rehabilitation, consideration of those who should not be referred is also important. There are few absolute contraindications to pulmonary rehabilitation, outside of a complete lack of motivation. Obviously in conditions where exercise would be painful (severe arthritis) or potentially dangerous (uncontrolled cardiovascular disease) the indication for rehabilitation needs to be very carefully considered, and risks and potential benefits must be carefully weighed. Co-morbidities are often thought of as a contra-indication for referral to pulmonary rehabilitation. In fact for many of the common co-morbidities of COPD (diabetes, obesity, cardiovascular disease, cognitive problems, depression, and osteoporosis) rehabilitation, including adapted exercise training, is a recommended treatment. Programs need to be adapted to the problems of these patients such that they benefit from the program both in terms of their COPD-related problems and in terms of their comorbidity²⁷.

Where should rehabilitation take place?

Pulmonary rehabilitation can be provided in several settings (table 2). Conventionally, programs were developed as outpatient programs where patients visited clinical facilities on a regular basis, typically two to three times per week. Another setting where pulmonary rehabilitation initially proved to be effective was the in-patient setting. More recently, pulmonary rehabilitation has been delivered successfully in alternative settings such as primary care (i.e. in the home of the patient, or in a primary care health care provider's office, typically a physiotherapy office), in secondary care (i.e. regional hospitals), in the community, or in nursing homes²⁹. Even more recently, telehealth applications started making their way to the rehabilitation field in order to ensure proper follow-up of patients³⁰.

Few studies have compared different settings head to head. Two study compared home based to outpatient rehabilitation and found largely equivalent effects.^{31;32} A third large study is currently underway³³. Similarly, a non randomized study in Denmark confirmed comparable effects of rehabilitation in primary and secondary care³⁴. Another study compared community based to hospital outpatient based rehabilitation, again without clear benefits of one program over the other³⁵. In a Brazilian study unsupervised home based rehabilitation showed significant benefits which were not different from outpatient rehabilitation in improvements on the six minute walking test. A study that used a similar comparison, that focused on more physiologic outcomes, however showed superiority of a supervised outpatient program^{36;37}. In a systematic review the effects of home based rehabilitation were confirmed³⁸. Even in the home setting several types of exercise training (strength or endurance) can be successfully applied³⁹. It needs to be acknowledged that home based programs for the most severely disabled patients may not be suitable^{39;40}.

It is of note that effectiveness of outpatient rehabilitation for patients with COPD has been confirmed outside the context of clinical trials^{41;42}. To the best of our knowledge, the effectiveness of home based programs has only been demonstrated in the context of formal clinical trials, where the administered by experts in the field. Such expertise may not be present when a trial is initiated in primary care practices.

Outpatient programs in specialized centers

Outpatient hospital-based programs have been successfully used to offer pulmonary rehabilitation to patients with COPD, and most of the data demonstrating successful outcomes comes from this setting. Outpatient programs have an advantage in that they can rely on an already existing multidisciplinary expertise to assess the patients and to individually tailor the rehabilitation program to the patient's needs. Programs are typically run by dedicated and very skilled staff. These programs allow for inclusion of complex patients and those with rare diseases or conditions such as restrictive

lung disease, pulmonary hypertension of patients before or after lung transplantation. Due to the available multidisciplinary staff, programs can be easily adapted to the specific needs of patients. Disciplines that can be involved in the rehabilitation process of a patient are the medical doctor (chest physician, specialized in rehabilitation), physiotherapist, specialized nurse, occupational therapist, nutritional specialist, psychologist, a social worker and the patient's general practitioner. Whereas the benefits of exercise training are clear at a group level, other disciplines may contribute with targeted intervention to selected patients.

Patient mobility and transportation issues are a major problem in adherence to outpatient problems, and are probably the number one reason why patients opt out of participation. Another issue is the relatively limited number of programs available. In Belgium, for example only four centers are currently allowed to run highly specialized rehabilitation that is properly reimbursed to its complexity. These programs have altogether a capacity of about 300 patients per year, which is insufficient to serve all potential candidates. In addition, outpatient hospital-based programs are generally more expensive compared to programs offered in primary care or in the community. The latter argument, however should be given less weight as even in a more expensive rehabilitation center setting the cost of a rehabilitation program is affordable and effects at the patient level are largely clinical relevant.

Inpatient rehabilitation

Pulmonary rehabilitation provided in the inpatient setting generally has the same benefits as programs provided in outpatient hospital-based settings. An additional benefit to an inpatient program is the full time availability of the patient to the rehabilitation team, allowing even more multidisciplinary work. In such programs other rehabilitation modules can be relatively easily implemented. An example is the implementation of a balance training program that successfully improved patients balance and confidence of balance⁴³. Obviously transportation is not an issue, but the patient has to agree to be taken out of his/her daily routine for extended periods of time. Typically programs are shorter than outpatient programs lasting around four weeks.

The major disadvantage of inpatient programs is their increased cost and – although not much studied - the potential risk of being institutionalized. In addition most health care systems will only allow for a very limited number of rehabilitation beds (if any), limiting the number of potential beneficiaries of these programs, regardless of the cost.

The short term effectiveness of inpatient programs has been well established²⁸. Such programs may be of particular importance for patients with end-stage lung disease, those awaiting lung

transplantation⁴⁴ or in patients that suffered from acute exacerbations. For the latter group of patients programs can be short with an aim toward preventing the exacerbation-related deterioration in functional performance and muscle strength⁴⁵. Such short programs need to be followed-up by subsequent longer-term outpatient-based rehabilitation. In one study a follow-up home based rehabilitation program was successful in maintaining benefits of the initial hospital based program⁴⁶. When programs are initiated during admissions for COPD exacerbations, elements of multidisciplinary geriatric rehabilitation may also be beneficial as a component to the inpatient program.⁴⁷ Additionally, special attention should be paid to the mental health of patients in this setting. Depression and anxiety are independent risk factors for the adverse outcome of hospital admissions related to exacerbations⁴⁸. The rehabilitation team is well placed to identify and tackle these problems.

Rehabilitation in primary care

Pulmonary rehabilitation can also be conducted successfully in the primary care setting. The major advantage for this venue is that the program is conducted in the patient's locale, thus facilitating easier access and perhaps a greater likelihood of initiating the intervention. A less explored potential advantage is that since participation takes place in more familiar settings the translation of benefits into enhanced physical activity into the home and community settings might be enhanced⁴⁹. Studies performed in primary care have demonstrated that exercise training can be successfully executed. Programs can be conducted in the physiotherapy office where equipment for exercise training is typically available.^{50;51} Alternatively, the pulmonary rehabilitation may be conducted in the patient's home;^{40;52} this may only be feasible if the proper exercise equipment is placed in the home³¹ and proper instruction and monitoring is provided. Furthermore, a bottle neck to delivery of rehabilitation in the primary care or home setting is the unavailability of a multidisciplinary team to assess the patient and direct the complex intervention in multi-morbid patients. When these programs can make use of a network which embeds a specialized center where the assessment can take place and a proposal for a program can be made these hurdles can be overcome. Home exercises are sometimes prescribed without supervision. Although these may improve patient centered outcomes and functional exercise capacity³² their effectiveness on physiological outcomes has not been shown.

Community centers

The use of community centers for pulmonary rehabilitation may also alleviate the travel burden for patients, yet allow for group training supervised by physical therapists in a location that has appropriate equipment for exercise training in elderly or frail subjects. Community-centered pulmonary rehabilitation has been deployed successfully in stable respiratory patients in the form of maintenance programs^{53;54}, or as primary programs⁵⁵. Typically the expertise to these programs is offered through an affiliated center of excellence. Recently a community based program was combined with telehealth support from a specialized center to deploy rehabilitation and education in the remote community³⁰. These new and creative solutions may offer new opportunities to respiratory health care providers living remote from a rehabilitation center.

Tele-health

A more recent development in broadening the applicability of pulmonary rehabilitation is the initiation of tele-health applications⁵⁶. This allows for remote monitoring by dedicated health care providers operating from specialized centers of the patients' training progress and of potential problems occurring during the training. Internet based programs enable the 'presence' of the rehabilitation team in the patient's house through educational programs, videoconferencing or tele-monitoring. Although theoretically possible, feasible and potentially effective⁵⁷ there are still a number of barriers to the adoption of tele-health. These include the requirement for technical competence, the potential experience of disrupted services, and the thought that opting into these services would cause disruptive changes to existing services⁵⁸. It still must be determined from large multicenter studies whether tele-rehabilitation is a feasible option in patients with respiratory disease, including whether tele-health solutions can have a role in the maintenance of physical activity levels and whether it can be useful for monitoring and early detection of symptoms from exacerbations.

Duration of rehabilitation

The duration of the pulmonary rehabilitation program remains a highly debated topic, and – to date – no consensus has been reached as to how long the intervention should last. In most guidelines a minimal duration of 6 to 8 weeks is mentioned⁴, but it is clear that longer programs may potentially render larger and more comprehensive benefits. Ideally, the rehabilitation intervention should last as long as gains are being made. However, the duration of programs is practically defined by the available health care (reimbursement) system rather than by the individual patient need. The impact

of varying duration of programs has been studied only at a group level, rather than at the individual patient level. At a group level longer programs may be beneficial, but it would be hard to believe that rehabilitation provides optimal results after a given number of weeks in every single patient and for every desired outcome. One study for example suggested that, while benefits of a program in functional exercise tolerance were observed after three months, benefits in terms of enhanced physical activity levels were only observed after six months of rehabilitation⁵⁹.

Duration and setting cannot be seen independently. Inpatient programs for patients experiencing exacerbations of COPD typically are very short in duration, often lasting days or a few weeks. Even for respiratory patients who are clinically stable, it is generally economically unfeasible to make inpatient programs longer than few weeks in duration. Outpatient programs, in contrast, can extend out to three to six months. Finally, community programs may be set up as permanent maintenance programs⁵⁴. Flexibility among settings may be a way forward in rehabilitation of patients with respiratory diseases. Rehabilitation may be seen more as a flexible plan of care not specifically tied to one single institution, rather than a specific package in one center and lasting just a few weeks. Few studies have explored this concept of using home based rehabilitation to sustain benefits of an inpatient program started in patients suffering from exacerbations⁴⁶ or exploring community based rehabilitation following inpatient rehabilitation⁶⁰.

In summary

From a group perspective, pulmonary rehabilitation has produced positive and clinically-meaningful effects across multiple outcome areas in patients with chronic respiratory diseases. This has certainly raised enthusiasm for pulmonary rehabilitation among clinicians and third party payers, and has ensured its status as a gold standard of treatment for patients with chronic respiratory disease such as COPD GOLD category B. The decision whether a patient is a good candidate for rehabilitation, the place of his or her rehabilitation program and the duration of this intervention, however, are not as straightforward as one might imagine. Rather than basing the type, location and duration of the therapy on the unique needs of the patient, regional healthcare restrictions may limit referral to programs and may fix their duration and location. Ideally, flexibility should be available which would reflect the medical and the patient needs (in terms of complexity and desired goals) and, importantly, the patient preferences in terms of location and duration of programs. This chapter has stressed the desirability for personalized, flexible approaches to pulmonary rehabilitation in terms of referral, location and duration. However, more research is needed to see if these approaches have the anticipated benefits. In the absence of research that proves that such personalized, flexible programs lead to better outcomes, render more cost-effective results, and have improved uptake

and adherence, we must rely on conventional wisdom. In general, programs should be at least 8 weeks long. Indications for referral include those patients recovering from severe exacerbations of their respiratory disease and those patients who walk slower than people of their age due to breathlessness or other exercise related symptoms. Additionally, patients with less severe symptoms may also benefit from rehabilitation, and likely programs for these patients can be set-up in less costly settings, such as primary care or community locations.

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Table 1 British Thoracic Society referral to pulmonary rehabilitation based on MRC dyspnoea scale

- ▶ Patients with a Medical Research Council (MRC) Dyspnoea score of 3–5 who are functionally limited by breathlessness should be referred for outpatient pulmonary rehabilitation. (Grade A)
- ▶ Patients with a MRC dyspnoea score of 2 who are functionally limited by breathlessness should be referred for pulmonary rehabilitation. (Grade D)
- ▶ Patients with a MRC dyspnoea score of 5 who are housebound should not routinely be offered supervised pulmonary rehabilitation within their home. (Grade B)
- ▶ Flexible and pragmatic approaches should be considered to facilitate exercise training in patients who have less severe COPD and who are less breathless. (expert consensus)

Table 2 an overview of possible locations for rehabilitation programs

type program	ran from	typical duration	multi-discipl	which patient
Inpatient	dedicated rehabilitation center	4 weeks	++++	complex patients with limited mobility or poor social support Post ICU
Outpatient	dedicated rehabilitation center	6 weeks to 6 months	+++	complex patients with sufficient social support post exacerbation
Outpatient	second line hospital	6 to 12 weeks	++	less complex patient
Community based	fitness center, gym	8 to 12 weeks or maintenance	+/-	Patients who need exercise only
Community based	nursing home	maintenance exercise	+	institutionalized patients
Primary care based	physiotherapy practice	8 to 12 weeks	+/-	Mobile Patients who need exercise only and/or respiratory physiotherapy (mucous problems)
Home based	with PT supervision	12 weeks	-	less mobile patients who need exercise only and/or respiratory physiotherapy (mucous problems)
Home based	without supervision	n.a.	-	Patients who need only physical activity and mild exercises with proper self management
Home based telemonitored		maintenance or primary	++ (educ.)	Patients who need mostly exercise and can manage technology

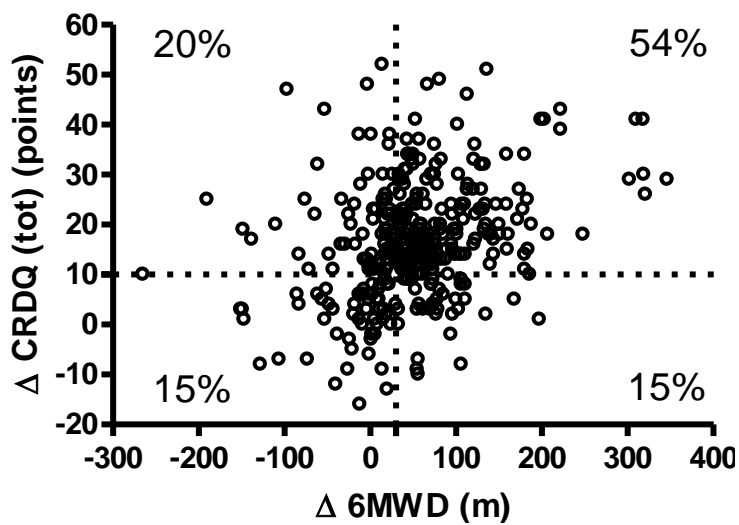


Figure 1 Effects of 3 months (3.week⁻¹) outpatient rehabilitation on functional exercise capacity and on health related quality of life in 352 consecutive COPD patients referred for pulmonary rehabilitation. Approximately 35% of patients had less than 30m improvement in 6MWD, approximately 26% of patients had less than 10 points improvement in HRQoL. Only 15% of patients did not meet both criteria, whereas 54% did meet both criteria.