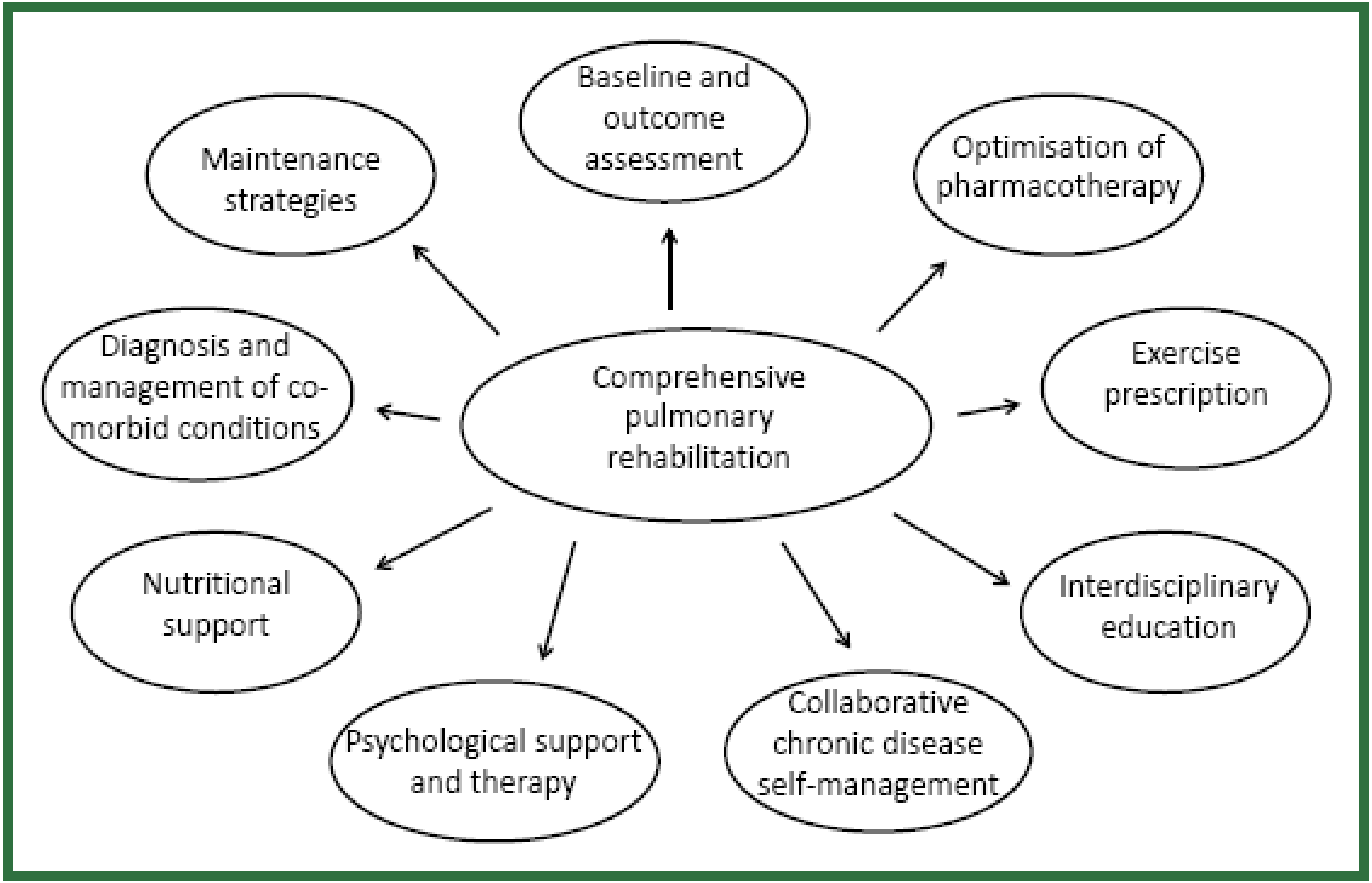
PULMONARY REHABILITATION Current Evidence and Recommendations

Overview

- Introduction to Pulmonary Rehabilitation
- Pathophysiolgy of Exercise Limitation
- Exercise training
- Current evidence for COPD
- Current evidence for diseases other than COPD
- Miscellaneous
- Current recommendations
- Take Home message

Date	Definition
1981 (1974)	Pulmonary rehabilitation is an art of medical practice wherein an *individually* tailored, *multidisciplinary* program is formulated, which through accurate diagnosis, therapy, emotional support, and education stabilizes or reverses both the physiology and psychology of pulmonary diseases and attempts to return the patient to the highest possible functional capacity allowed by his pulmonary handicap and overall life situation. Goals are (1) control and alleviate symptoms and complications of respiratory impairment, and (2) teach patients optimal capability to carry out activities of daily life.
1999	(No definition) The principal goals of pulmonary rehabilitation are to reduce symptoms, decrease disability, increase participation in physical and social activities, and improve the overall quality of life for individuals with chronic respiratory disease.
2006	Pulmonary rehabilitation is an evidence-based, *multidisciplinary*, and *comprehensive intervention* for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities. Integrated into the individualized treatment of the patients, it is designed to reduce symptoms, optimize functional status, increase participation, and reduce health care costs through stabilizing or reversing systemic manifestations of the disease.
2013	Pulmonary rehabilitation is a *comprehensive intervention* based on a thorough patient assessment followed by *patient-tailored* therapies, which include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors.


Baseline and outcome assessment
Maintenance strategies
Optimisation of pharmacotherapy
Diagnosis and management of co-morbid conditions
Comprehensive pulmonary rehabilitation
Exercise prescription
Nutritional support
Interdisciplinary education
Psychological support and therapy
Collaborative chronic disease self-management

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Muscle: Quantity

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Quadriceps strength predicts mortality in patients with moderate to severe chronic obstructive pulmonary disease

Elisabeth B Swallow, Diana Reyes, Nicholas S Hopkinson, William D-C Man, Raphaël Porcher, Edward J Cetti, Alastair J Moore, John Moxham, Michael I Polkey

Thorax 2007;**62**:115–120. doi: 10.1136/thx.2006.062026

Swallow EB, Reyes D, Hopkinson NS, et al. Thorax 2007;62(2):115–20

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increased hospital admissions.

Muscle: Quantity

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eps

muscle

Swallow EB,

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Midthigh Muscle Cross-Sectional Area Is a Better Predictor of Mortality than Body Mass Index in Patients with Chronic Obstructive Pulmonary Disease

Karine Marquis, Richard Debigaré, Yves Lacasse, Pierre LeBlanc, Jean Jobin, Guy Carrier, and François Maltais

Centre de recherche, Hôpital Laval, Institut Universitaire de Cardiologie et de Pneumologie de L'Université Laval, Québec, Canada

Marquis K, Debigare R, Lacasse Y, et al. Am J Respir Crit Care Med 2002;166(6):809–13

Muscle: Quantity

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and François Maltais

Québec, Canada

2002;166(6):809–13

Eur Respir J 1997; 10: 417–423
DOI: 10.1183/09031936.97.10020417

European Respiratory Journal
ISSN 0903 - 1936

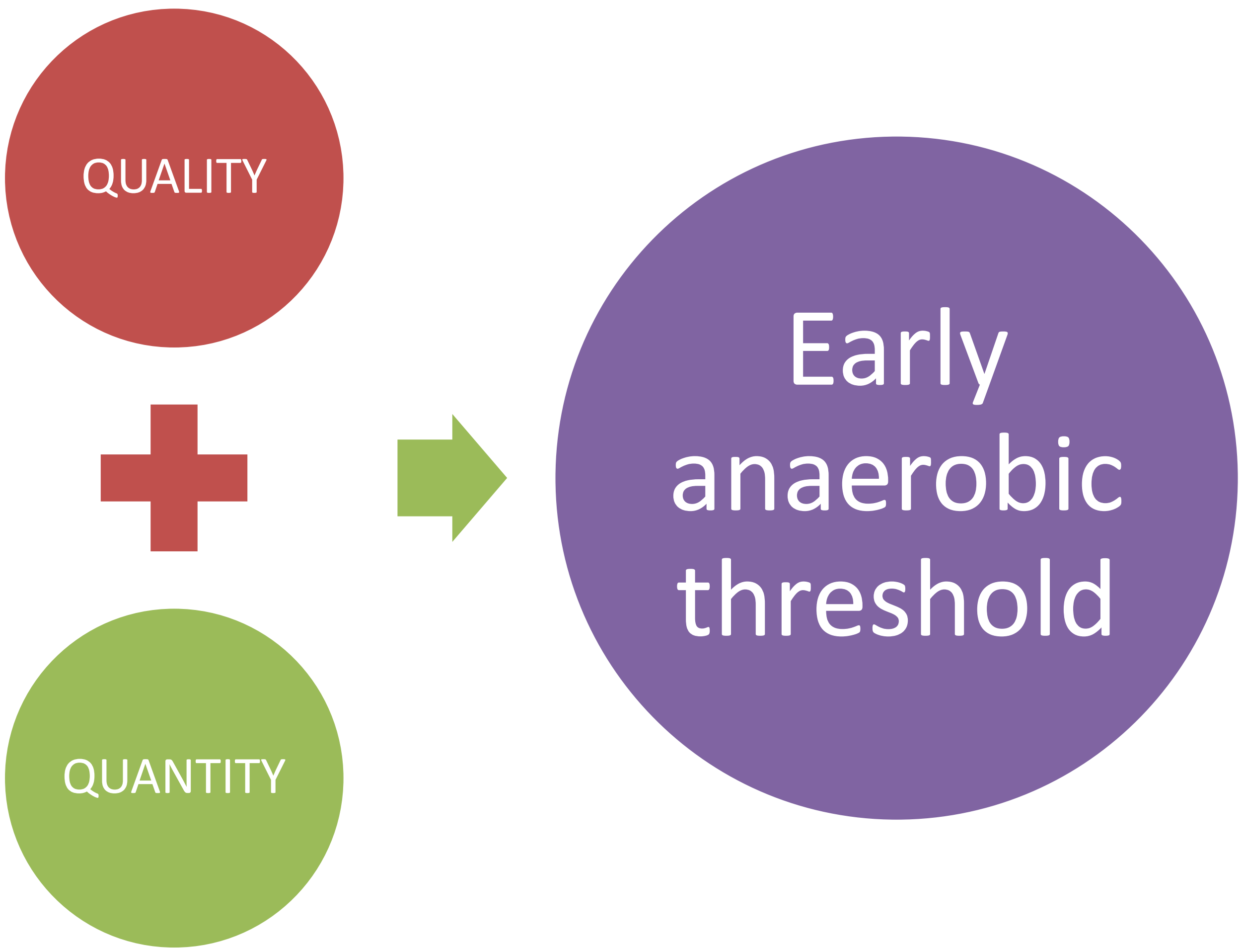
Muscle weakness is related to utilization of health care resources in COPD patients

Decramer M, Gosselink R, Troosters T, et al. Eur Respir J 1997; 10(2):417–23.

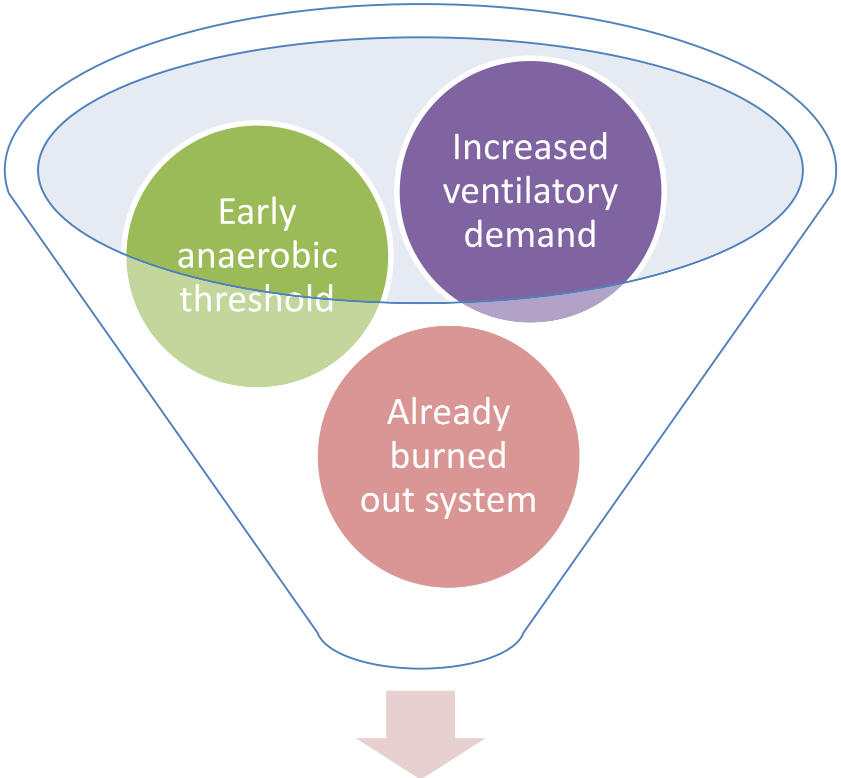
Muscle Quality

- The muscle quality is also impaired; there is preferential reduction in the type I fiber cross-sectional area in the quadriceps muscle in COPD, and reduced oxidative enzyme concentration, mitochondrial density and capillary density.

- Eur Respir J 1999;13(4):850–4.
- Med Sci Sports Exerc 1998;30(10):1467–74.
- Am J Respir Crit Care Med 1996;153(1):288–93.
- Eur Respir J 2007;30(1):73–9.



Thorax 2005;60(11):932–6.



TERMINATION OF EXERCISE

- Lower limb aerobic and strength training are therefore essential components of a pulmonary rehabilitation program.

- Thorax 2013;68(Suppl 2):ii1–30.
- Am J Respir Crit Care Med 2013;188(8):e13–64.

Most are partially amenable to rehab

- peripheral muscle dysfunction
- dynamic hyperinflation
- increased respiratory load
- defective gas exchange
- age-related decline in function
- physical deconditioning
- comorbid conditions

•Aliverti A, Macklem PT. J Appl Physiol 2008;105:749–751
•Debigaré R, Maltais F. J Appl Physiol 2008;105:751–753
•O'Donnell DE, Webb KA. J Appl Physiol 2008;105:753–755
•Spruit MA, Franssen FM, Rutten EP, Wagers SS, Wouters EF. Rev Bras Fisioter 2012;16:148–156.

The exertional dyspnea in COPD is usually multifactorial :

- peripheral muscle dysfunction
- dynamic hyperinflation
- increased respiratory load
- defective gas exchange
- age-related decline in function
- physical deconditioning
- comorbid conditions

•exercise training lead to

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ventilatory requirement for a given submaximal work rate

•Reduced ventilatory requirement leads to reduction in dynamic hyperinflation

•Reconditioning of Muscle groups

•Reduced mood disturbance

•Improved cardiovascular function

•Chest 2005;128:2025–2034

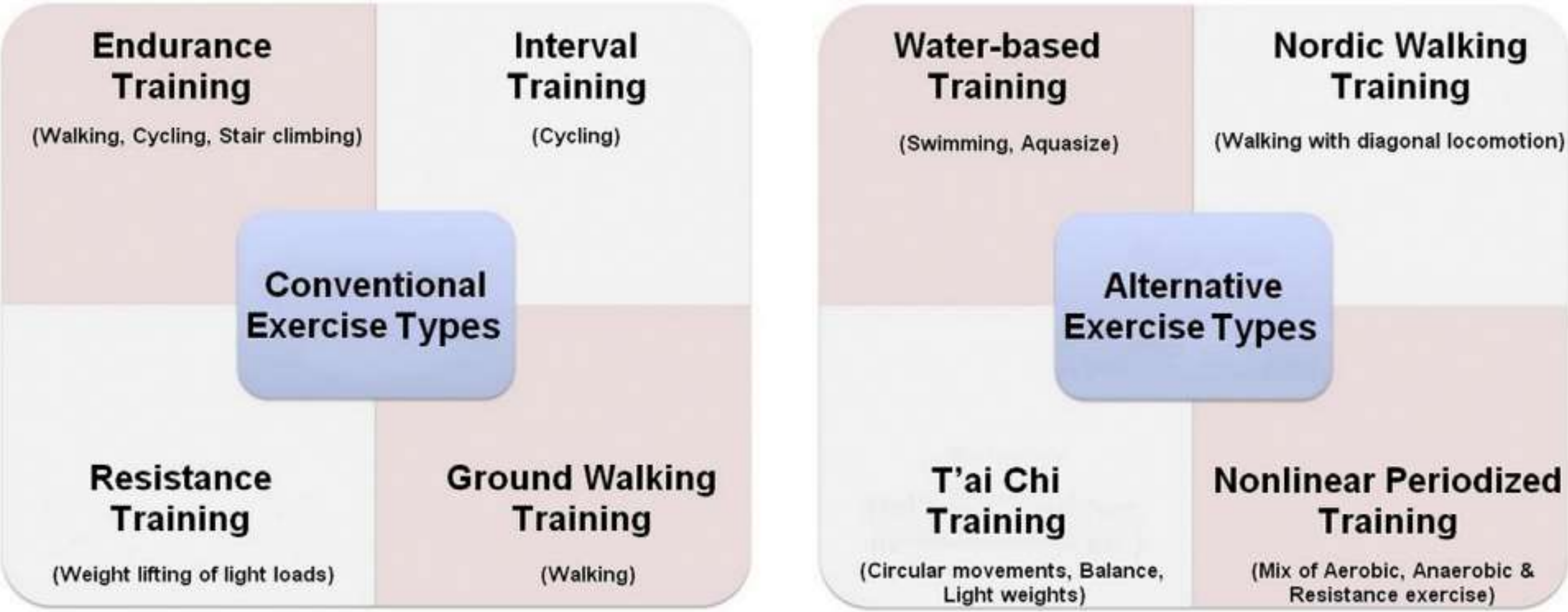
Before starting an exercise program

- Exercise assessment to individualize prescription
- Potential need to supplement oxygen
- Rule out cardiovascular comorbidity
- CPET : optional
- Identifying single variable is difficult

Principles of Exercise training

- Total training load must reflect individuals specific requirements
- Must exceed loads encountered in ADL
- Must progress as improvement occurs

Types of exercise in COPD



Modes of Exercise training

- Endurance training
- Interval training
- Resistance training
- Neuromuscular electrical stimulation
- Respiratory muscle training.

Endurance Training

- Aims
  - Condition muscles of ambulation
  - Improve cardiorespiratory fitness
- FITT
  - Frequency
  - Intensity
  - Time
  - Type

•American College of Sports Medicine. American College of Sports Medicine position stand: Med Sci Sports Exerc 2011;43:1334–1359

- Endurance exercise training in the form of cycling or walking exercise is the most common type of applied exercise modality in pulmonary rehabilitation
- Endurance exercise training in individuals with chronic respiratory disease is prescribed at the frequency of three to five times per week.
- A high level of intensity of continuous exercise (60% maximal work rate)
- for 20 to 60 minutes (time) per session
- maximizes physiologic benefits
    - exercise tolerance
    - muscle function
    - bioenergetics

•American College of Sports Medicine. American College of Sports Medicine position stand: Med Sci Sports Exerc 2011;43:1334–1359

- A Borg dyspnea or fatigue score of 4 to 6 (moderate to [very] severe) is often considered a target training intensity.

•Chest 1996; 109:1169–1175.

Nordic Walking improves daily physical activities in COPD: a RCT

Nordic Walking improves daily physical activities in COPD: a RCT

- P: 60 COPD patients
- I: one hour nordic walking at 75% maximal heart rate (3 month follow up, analysis after 6 weeks)
- C: No active exercise
- O: Daily physical activities

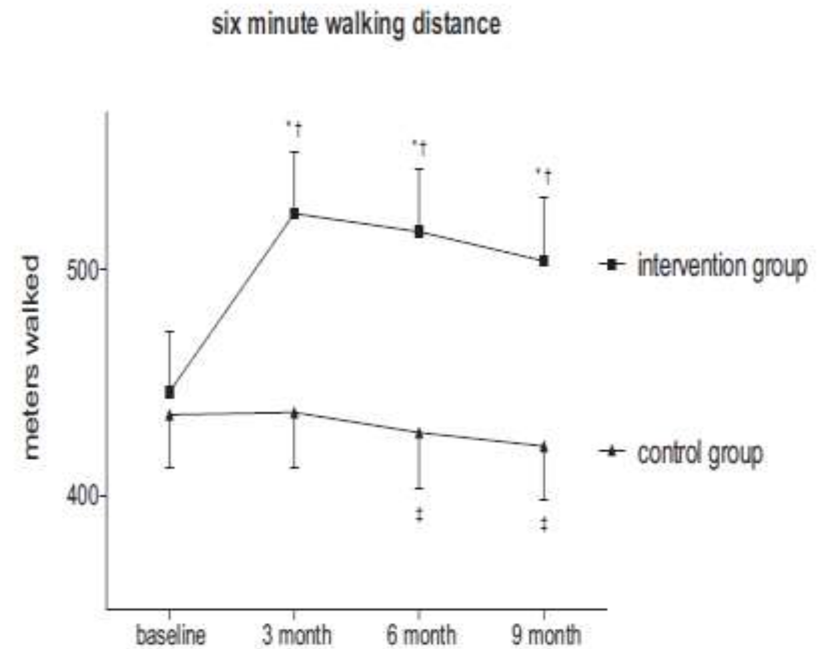


Figure 4 Six-minute walking distance of COPD patients of intervention and control group over time. Statistical comparisons within groups: * $p < 0.01$ compared to baseline; † $p < 0.05$ compared to baseline; statistical comparison between groups (intervention vs. control): ‡ $p < 0.01$ at all times. (Whiskers represent SD).

•Respir Res 2010;11:112.

Interval Training

- Interval training: an alternative to standard endurance training
- a modification of endurance training in which high-intensity exercise is regularly interspersed with periods of rest or lower intensity exercise.
- This results in significantly lower symptom scores despite high absolute training loads, thus maintaining the training effects of endurance training.

•Eur Respir J 2002;20:12–19
•Eur Respir J 2010;36:301–310
J Cardiopulm Rehabil Prev 2009;29: 126–132

Interval versus continuous training

Abstract

Background In patients with chronic obstructive pulmonary disease (COPD), interval exercise has gained recent attention as a possible means of achieving greater physiological training effects compared with continuous exercise. The primary aim of this systematic review was to compare the effects of interval versus continuous training on peak oxygen uptake, peak power, 6 minute walk test (6MWT) distance and health-related quality of life in individuals with COPD.

Methods Randomised controlled trials comparing the effects of interval versus continuous training in patients with COPD were identified after searches of six databases and reference lists of appropriate studies in May 2009. Two reviewers independently assessed study quality. Weighted mean differences (WMD) with 95% CIs were calculated using a random effects model for measures of exercise capacity and health-related quality of life.

Results: Eight randomised controlled trials, with a total of 388 patients with COPD, met the inclusion criteria. No significant differences were found for peak power (WMD 1 W, 95% CI −1 to 3) or peak oxygen uptake (WMD −0.04 l/min, 95% CI −0.13 to 0.05) between interval and continuous training. The WMD for the Chronic Respiratory Questionnaire dyspnoea score was −0.2 units (95% CI −0.5 to 0.0). There was no difference in 6MWT distance between groups (WMD 4 m, 95% CI −15 to 23).

Conclusions Interval and continuous training modalities did not differ in their effect on measures of exercise capacity or health-related quality of life. Interval training may be considered as an alternative to continuous training in patients with varying degrees of COPD severity.

•Thorax 2010;65:157–164

- For individuals with chronic heart failure a high-intensity interval training program was superior to moderate-intensity continuous training at matched work for both exercise capacity and quality of life

- Circulation 2007;115:3086–3094

Resistance/Strength Training

- Resistance (or strength) training is an exercise modality in which local muscle groups are trained by repetitive lifting of relatively heavy loads
- Improved muscle mass
- Reduced risk of falling
- Improving BMD

•Am J Respir Crit Care Med 2002;166:809–813

- Endurance training: suboptimal increases in muscle mass or strength compared with programs that include specific resistance exercise
- Moreover, strength training results in less dyspnea during the exercise period, thereby making this strategy easier to tolerate than endurance constant-load training .

•Chest 2004;125:2036–2045
•Eur Respir J 2000;15:92–97

- No optimal resistance training prescription
- 1 to 3 sets of 8 to 12 repetitions should be undertaken on 2 to 3 days each week
- The exercise dosage must increase over time (the so-called overload) to facilitate improvements in muscular strength and endurance.

•Chest 2009;136:1269–1283

- When added to a program of endurance constant-load exercise, resistance training confers additional benefits in muscle force, but not in overall exercise capacity or health status.

•Chest 2004;125:2036– 2045

- the combination of constant-load/interval and strength training improves outcome to a greater degree than either strategy alone in individuals with chronic respiratory disease, without unduly increasing training time

•Am J Respir Crit Care Med 2002;166:669–674.

Upper Limb Training

- Examples of upper extremity exercises include
  - aerobic regimens
    - » arm cycle ergometer training
  - resistance training
    - » training with free weights
    - » Training with elastic bands

Upper extremity training

- increases upper limb function
- the optimal approach to training remains to be determined.
- to what extent specific gains in upper limb function translate into improvements in health related quality of life is not clear

•Chest 2009;136:387–395
•Chest 2011;139:151–158

Flexibility Training

- Although flexibility training is a component of many exercise regimens in pulmonary rehabilitation, there are, to date, no clinical trials demonstrating its effectiveness in this particular setting

Neuromuscular Electrical Stimulation

- Transcutaneous neuromuscular electrical stimulation (NMES) of skeletal muscle is an alternative rehabilitation technique wherein muscle contraction is elicited, and selected muscles can thereby be trained, without the requirement for conventional exercise
- Muscle contraction induced by electrical stimulation
  - does not lead to dyspnea,
  - minimal cardiocirculatory demand,
  - bypasses the cognitive, motivational, and psychological aspects that may hinder or prevent effective exercise training

•Respir Med 2008;102:786–789
•Lung 2011;189: 21–26.

- The mechanisms by which NMES improves muscle function and exercise capacity or performance are incompletely understood.
- The pattern of muscle fiber activation during NMES may differ from that which occurs during conventional exercise.
- Specifically, the frequency of stimulus delivered likely determines the types of muscle fibers activated.
- A NMES stimulus frequency up to 10 Hz likely preferentially activates slow twitch fibers and may selectively improve resistance to fatigue, whereas a frequency greater than 30 Hz may activate both types of fibers, or may selectively recruit fast-twitch fibers and enhance power .

•Crit Care 2010;14:R74.
•Phys Ther 2005;85:358–364

- Frequencies ranging between 35 to 50 have been used for COPD
- Some investigators advocate delivery of a combination of stimulus frequencies during NMES training to most closely mimic normal motor neuron firing patterns and have maximal impact on muscle function .
- There are no formal patient candidacy guidelines for NMES.

•Phys Ther 2005;85:358–364

- NMES is safe and generally well tolerated. The adverse effect reported most commonly is mild muscle soreness that usually resolves after the first few NMES session
- Contraindications like pacemaker devices and implanted defibrillator are expert opinion

•Exerc Sport Sci Rev 2007;35:180–185

Inspiratory Muscle Training

- The pressure-generating capacity of the inspiratory pump muscles is reduced in individuals with COPD
- Endurance exercise training, despite conferring large gains in exercise capacity and reducing dyspnea, does not appear to improve the pressure-generating capacity of the inspiratory muscles, likely because the ventilatory load during whole-body exercise is of insufficient magnitude to confer a training adaptation

•Am J Respir Crit Care Med 2002;166:809–813

Inspiratory Muscle Training in Patients with Chronic Obstructive Pulmonary Disease: The State of the Evidence

The clinical benefits of improved inspiratory muscle strength and endurance resulting from IMT appear to include improvements in dyspnea, walking test distance, and HRQL.

However, the strength of these conclusions must be considered in the context of several limitations to the body of evidence regarding the use of IMT in individuals with COPD.

Additionally, it is not clear who would benefit most from IMT and what training regimen is optimal

•Respir Med 2008;102: 1715–1729

Guidelines

Table 3.5. Benefits of Pulmonary Rehabilitation in COPD

- Improves exercise capacity (**Evidence A**).
- Reduces the perceived intensity of breathlessness (**Evidence A**).
- Improves health-related quality of life (**Evidence A**).
- Reduces the number of hospitalizations and days in the hospital (**Evidence A**).
- Reduces anxiety and depression associated with COPD (**Evidence A**).
- Strength and endurance training of the upper limbs improves arm function (**Evidence B**).
- Benefits extend well beyond the immediate period of training (**Evidence B**).
- Improves survival (**Evidence B**).
- Respiratory muscle training can be beneficial, especially when combined with general exercise training (**Evidence C**).
- Improves recovery after hospitalization for an exacerbation [524] (**Evidence A**).
- Enhances the effect of long-acting bronchodilators (**Evidence B**).

Guidelines

- All patients who get short of breath when walking on their own pace on level ground should be offered rehabilitation; it can improve symptoms, quality of life, and physical and emotional participation in everyday activities.

Guidelines

U11	**NEW 2010 UPDATE RECOMMENDATION 11 (U11)** Pulmonary rehabilitation should be made available to all appropriate people with COPD (see R84) including those who have had a recent hospitalisation for an acute exacerbation.	
R84	Pulmonary rehabilitation should be offered to all patients who consider themselves functionally disabled by COPD (usually MRC grade 3 and above). Pulmonary rehabilitation is not suitable for patients who are unable to walk, have unstable angina or who have had a recent myocardial infarction.	**Grade D**
R85	For pulmonary rehabilitation programmes to be effective, and to improve concordance, they should be held at times that suit patients, and in buildings that are easy for patients to get to and have good access for people with disabilities. Places should be available within a reasonable time of referral.	**Grade D**
R86	Pulmonary rehabilitation programmes should include multicomponent, multidisciplinary interventions, which are tailored to the individual patient's needs. The rehabilitation process should incorporate a programme of physical training, disease education, nutritional, psychological and behavioural intervention.	**Grade A**

British Thoracic Society

Guidelines

- **What is the role of pulmonary rehabilitation?**
- 1. Structured pulmonary rehabilitation programs should be set up where feasible. (1A)
- 2. In the absence of structured programs, patients should be advised regarding unsupervised daily physical activity. (3A)

THE COCHRANE COLLABORATION®

- **Pulmonary rehabilitation for chronic obstructive pulmonary disease (Review)**

• Cochrane Database Syst Rev. 2015 Feb 23

CRQ

- **Description:** CRQ is an interviewer-administered questionnaire measuring both physical and emotional aspects of chronic respiratory disease.
- **Developer:** GH Guyatt MD
- **Administration:** Interview
- **Time to complete:** 15-25 minutes
- **Number of items:** 20
- **Domains & categories:** 4 categories: **Dyspnea, fatigue, emotional function, mastery**
- **Scoring**: Total score and subscores on categories; **higher scores indicate better health-related quality of life**
- A change in the score of 0.5 on the 7 point scale, reflects a clinical significant small change. A change of 1.0 reflects a moderate change and a difference of 1.5 represents a large change.
- **Minimally important difference**: Reflected by a change in score of 0.5 on a 7 point scale.

SGRQ

- **The SGRQ is a 50-item questionnaire developed to measure health status (quality of life) in patients with diseases of airways obstruction.**
- Scores are calculated for three domains:
  Symptoms, Activity and Impacts (Psycho-social) as well as a total score.
- Psychometric testing has demonstrated its repeatability, reliability and validity. Sensitivity has been demonstrated in clinical trials.
- A minimum change in score of 4 units was established as clinically relevant after patient and clinician testing.
- The SGRQ has been used in a range of disease groups including asthma, chronic obstructive pulmonary disease (COPD) and bronchiectasis, and in a range of settings such as randomised controlled therapy trials and population surveys.
- The SGRQ correlates significantly with other measures of disease activity such as cough, dyspnoea, 6-min walk test and FEV1 as well as other measures of general health such as the SIP and SF36

•Am Rev Respir Dis 1992;145:1321-1327.

THE COCHRANE COLLABORATION®

- **Background**

  Widespread application of pulmonary rehabilitation in COPD should be preceded by demonstrable improvements in function (health-related quality of life, functional and maximal exercise capacity) attributable to the programmes.

- **Objectives**

  To compare the effects of pulmonary rehabilitation versus usual care on health-related quality of life and functional and maximal exercise capacity in persons with COPD.

- **Search methods**

Randomised controlled trials (RCTs) from the Cochrane Airways Group Specialised Register. Searches were current as of March 2014.

Selection criteria

- RCTs of pulmonary rehabilitation in patients with COPD in which health-related quality of life (HRQoL) and/or functional (FEC) or maximal (MEC) exercise capacity were measured.
- Pulmonary rehabilitation was defined as exercise training for at least four weeks with or without education and/or psychological support.
- Usual care was defined as conventional care in which the control group was not given education or any form of additional intervention.

1. CRQ
    A. Fatigue
    B. Emotional function
    C. Mastery
    D. Dyspnea
2. SGRQ
    A. Total
    B. Symptoms
    C. Impact
    D. Activity
3. Maximal Exercise (ISWT)
4. Maximal Exercise capacity (cycle ergometer)
5. Functional Exercise capacity (6 MWD)

Rehabilitation versus usual care, Outcome 4 QoL - Change in CRQ (Dyspnoea)

Outcomes	Illustrative comparative effects* (95% CI)		Number of participants (studies)	Quality of the evide
	Response on control	Treatment effect		
	Usual care	Rehabilitation versus usual care		
QoL - Change in CRQ (dyspnoea) CRQ Questionnaire. Scale from 1 to 7 (Higher is better and 0.5 unit is an important difference) Follow-up: median 12 weeks	Median change = 0 units	Mean QoL - change in CRQ (Dyspnoea) in the intervention groups was **0.79 units higher** (0.56 to 1.03 higher)	1283 (19 studies)	⊕⊕⊕○ **Moderate**[1,2,3]

Rehabilitation versus usual care, Outcome 5 QoL - Change in SGRQ (Total)

Outcomes	Illustrative comparative effects* (95% CI)		Number of participants (studies)	Quality of the evide
	Response on control	Treatment effect		
	Usual care	Rehabilitation versus usual care		
QoL - Change in SGRQ (total) Scale from 0 to 100 (Lower is better and 4 units is an important difference) Follow-up: median 12 weeks	Median change = 0.42 units	Mean QOL - change in SGRQ (total) in the intervention groups was **6.89 units lower** (9.26 to 4.52 lower)	1146 (19 studies)	⊕⊕⊕○ **Moderate**[2,3,4]

Rehabilitation versus usual care, Maximal Exercise (Incremental shuttle walk test)

Outcomes	Illustrative comparative effects* (95% CI)		Number of participants (studies)	Quality of the evidence (GRADE)
	Response on control	Treatment effect		
	Usual care	Rehabilitation versus usual care		
Change in maximal exercise (Incremental Shuttle walk test (ISWT)) Distance metres Follow-up: median 12 weeks	Median change = 1 metre	Mean maximal exercise (incremental shuttle walk test) in the intervention groups was **39.77 metres higher** (22.38 to 57.15 higher)	694 (8 studies)	⊕⊕⊕○ **Moderate**[2,3,5]

Rehabilitation versus usual care, Functional Exercise Capacity (6MWT)

Outcomes	Illustrative comparative effects* (95% CI)		Number of participants (studies)	Quality of the evidence (GRADE)	Comments
	Response on control	Treatment effect			
	Usual care	Rehabilitation versus usual care			
Change in functional exercise capacity (6MWT)) Distance metres Follow-up: median 12 weeks	Median change = 3.4 metres	Mean functional exercise capacity (6MWT)) in the intervention groups was **43.93 metres higher** (32.64 to 55.21 higher)	1879 (38 studies)	⊕○○○ **Very low**[2,3,6,7]	

Rehabilitation versus usual care, Maximal Exercise Capacity (cycle ergometer)

Outcomes	Illustrative comparative effects* (95% CI)		Number of participants (studies)	Quality of the evidence (GRADE)
	Response on control	Treatment effect		
	Usual care	Rehabilitation versus usual care		
Change in maximal exercise capacity (cycle ergometer) Workmax (watt) Follow-up: median 12 weeks	Median change = -0.05 watts	Mean maximal exercise capacity (cycle ergometer) in the intervention groups was **6.77 watts higher** (1.89 to 11.65 higher)	779 (16 studies)	⊕⊕◯◯ **Low**[2,3,8,9]

Rehabilitation versus usual care (subgroup analysis hospital vs community)

- Evidence suggested a significant difference in treatment effect between subgroups for all domains of the CRQ, with higher mean values, on average, in the PR group in hospital than in the community- based group.
- No subgroup differences were reported for any of the SGRQ domains

Pulmonary rehabilitation versus usual care. Subgroup: community versus hospital-delivered programme

Outcome	Subscale	Subgroups	Heterogeneity	MD [95% CI]	Test for subgroup differences
CRQ	Fatigue	Community	$Tau^2 = 0.10; I^2 = 52\%$	0.44 [0.14, 0.75]	$Chi^2 = 3.98$, df = 1 (P value 0.05), $I^2 = 74.9\%$
		Hospital	$Tau^2 = 0.09; I^2 = 51\%$	0.86 [0.58, 1.14]	
CRQ	Emotional Function	Community	$Tau^2 = 0.00; I^2 = 0\%$	0.21 [0.04, 0.39]	$Chi^2 = 12.24$, df = 1 (P value 0.0005), $I^2 = 91.8\%$
		Hospital	$Tau^2 = 0.06; I^2 = 39\%$	0.77 [0.51, 1.03]	
CRQ	Mastery	Community	$Tau^2 = 0.07; I^2 = 45\%$	0.40 [0.12, 0.67]	$Chi^2 = 8.58$, df = 1 (P value 0.003), $I^2 = 88.3\%$
		Hospital	$Tau^2 = 0.05; I^2 = 31\%$	0.95 [0.70, 1.20]	
CRQ	Dyspnoea	Community	$Tau^2 = 0.03; I^2 = 26\%$	0.58 [0.34, 0.81]	$Chi^2 = 4.05$, df = 1 (P value 0.04), $I^2 = 75.3\%$
		Hospital	$Tau^2 = 0.17; I^2 = 60\%$	0.99 [0.66, 1.32]	
SGRQ	Total	Community	$Tau^2 = 24.00; I^2 = 73\%$	-8.15 [-12.16, -4.13]	$Chi^2 = 0.69$, df = 1 (P value 0.41), $I^2 = 0\%$
		Hospital	$Tau^2 = 6.41; I^2 = 35\%$	-6.05 [-8.91, -3.20]	
SGRQ	Symptoms	Community	$Tau^2 = 6.28; I^2 = 24\%$	-3.66 [-7.07, -0.24]	$Chi^2 = 1.65$, df = 1 (P value 0.20), $I^2 = 39.2\%$
		Hospital	$Tau^2 = 4.96; I^2 = 15\%$	-6.91 [-10.51, -3.30]	
SGRQ	Impact	Community	$Tau^2 = 19.91; I^2 = 63\%$	-8.17 [-12.00, -4.34]	$Chi^2 = 0.46$, df = 1 (P value 0.50), $I^2 = 0\%$
		Hospital	$Tau^2 = 22.39; I^2 = 58\%$	-6.21 [-10.33, -2.09]	
SGRQ	Activity	Community	$Tau^2 = 48.91; I^2 = 78\%$	-7.82 [-13.37, -2.28]	$Chi^2 = 0.93$, df = 1 (P value 0.33), $I^2 = 0\%$
		Hospital	$Tau^2 = 10.45; I^2 = 36\%$	-4.58 [-8.16, -1.00]	

Rehabilitation versus usual care (subgroup analysis ’exercise only’ vs ’exercise plus more comprehensive components’)

- No evidence was found of a significant treatment effect between subgroups for all domains of the CRQ and the SGRQ

AUTHORS' CONCLUSIONS

- Clinically and statistically significant improvements in important domains of health-related quality of life, including dyspnoea, fatigue, emotional function and mastery, in addition to the sixminute walk/distance test - a measure of functional exercise.

- With the support of current international statements or clinical practice guidelines targeting respiratory rehabilitation in COPD , we hope that the results of this meta-analysis will encourage the implementation of new programmes.

AUTHORS' CONCLUSIONS

- Overall, the conclusions of this meta-analysis are in agreement with those of prior meta-analyses published in 1996 and in 2001
- The addition of 34 RCTs since the 2006 update resulted, as expected, in narrowing of the CIs around the common effects of rehabilitation in the outcomes examined.

AUTHORS' CONCLUSIONS

- The subgroup analysis finding that identified a difference in treatment effect between hospital-based programmes and community-based programmes suggests that further research should be undertaken to compare these two approaches.
- Similarly, the fact that the subgroup analysis identified no differences between basic exercise PR programmes and those that provided more complex interventions suggests the need to examine and identify the most essential components of PR programmes for achieving the best patient outcomes.

Diseases other than COPD

Population	Evidence for PR	Outcomes of PR	Special Considerations
Interstitial lung disease	Two RCTs of exercise training*; one systematic review^	•Improved 6 min walk distance, dyspnea, and quality of life. •Magnitude of benefits smaller than that seen in COPD •Benefits not maintained at 6 mo	Supplemental oxygen should be available and appropriate monitoring of oxyhemoglobin saturation during exercise is indicated

•*Thorax 2008;63: 549–554
•Respirology 2008;13:394–399

•^Cochrane Database Syst Rev 2008;4:CD006322

Diseases other than COPD

Population	Evidence for PR	Outcomes of PR	Special Considerations
Bronchiectasis	One RCT of exercise +/- inspiratory muscle training*; one large retrospective study of standard PR ^	•Improvement in incremental shuttle walk test distance & endurance exercise time. •Benefits of equivalent magnitude to those seen in COPD	Role of airway clearance techniques not yet established

*Thorax 2005;60:943–948

•^Chron Respir Dis 2011;8:21–30

Diseases other than COPD

Population	Evidence for PR	Outcomes of PR	Special Considerations
Asthma	One systematic review *; two RCTs of exercise training^	Improved physical fitness, asthma symptoms, anxiety, depression, and quality of life	Preexercise use of bronchodilators and gradual warm up are indicated to minimize exercise induced Bronchospasm

- *Cochrane Database Syst Rev. 2005;4:CD001116

- ^Chest 2010;138:331–337
- Respiration 2011;81:302–310

Diseases other than COPD

Population	Evidence for PR	Outcomes of PR	Special Considerations
Pulmonary Hypertension	One RCT *; two prospective case series ^	Improved exercise endurance, WHO functional class, quality of life, increased peripheral muscle function.	•supplemental O2 should be available •BP and pulse should be monitored closely •Concurrent arm/leg exercises are generally not recommended

•*Circulation 2006;114:1482–1489

•^Cardiopulm Rehabil Prev 2010;30:319–32

•Respiration 2011;81:394–401

Diseases other than COPD

Population	Evidence for PR	Outcomes of PR	Special Considerations
Lung cancer Pre op	Small observational studies	Improved exercise tolerance	Short duration e.g. 2-4 wk, up to 5 times per week
Post op	One systemic review*	Increased walking endurance, increased peak exercise capacity, reduced dyspnea and fatigue	
Medical Management	Case series^	Improved symptoms and maintenance of muscle strength	

- *Lung Cancer 2011;72:139–153
- ^J Thorac Oncol 2009;4:595–601

Diseases other than COPD

Population	Evidence for PR	Outcomes of PR	Special Considerations
Lung Transplant Pretansplant	One RCT comparing interval versus continuous training*	Improved exercise tolerance and wellbeing	Lower intensity or interval training Educational component should cover surgical techniques, risks, benefits of the surgery, postoperative care
Post Transplant	Two RCTs^	Increased muscle strength, walking endurance, maximal exercise capacity, and quality of life	

- *J Heart Lung Transplant 2012;31:934–941

- ^J Heart Lung Transplant 2010;29:497–503
- Am J Transplant 2008;8:1275–1281

Program Organization in Pulmonary Rehabilitation

- Barriers
- Staffing
- Duration
- Setting

Barriers

- Inconvenience for the patient
- Lack of perceived benefit
- Transportation/travel issues
- Cost
- Illness severity
- Comorbidities
- Mood disorders
- Smoking

Staffing

The American Association of Cardiovascular and Pulmonary Rehabilitation recommends a staff-to-participant ratio of 1:4, and the British Thoracic Society a ratio of 1:8

Health Care Provider	Suggested Tasks
Chest physician (preferably with pulmonary rehabilitation specialty)	Medical treatment and patient referral Diagnosis and follow-up of comorbidities Setup and supervision of multidisciplinary team Referral for comorbidities
Exercise specialist (physiotherapist)	Setup and supervision of the exercise program Home exercise program (follow-up) Arrangement of maintenance training strategies
Psychologist	Management of uncertainty[23] Management of depression in depressed patients[24,a] Smoking cessation
Occupational therapist	Home energy efficiency[25] Specific training of home activities[26] Use of walking aids Pacing techniques
Nutritional experts	Management of overweight Management of cachexia Nutrient intake in line with exercise training program Nutritional supplements
Nurse specialist	Medication adherence Smoking cessation Self-management program for exacerbation management
Physiotherapist	Mucous clearance in patients with mucous hypersecretion and difficulties to clear spontaneously[5] Balance/proprioceptive training in frail patients at risk for falling[27]
Social worker	Solve transportation issues in outpatient programs Map out the social support network around a patient to anticipate on dropout[28] Implementation of social support measures provided by the health care system to alleviate financial burden

Indian Scenario

International Journal of COPD

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REVIEW

Correlation of health-related quality of life with other disease severity indices in Indian chronic obstructive pulmonary disease patients

• International Journal of COPD 2012:7 291–296

Indian Scenario

International Journal of COPD

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REVIEW

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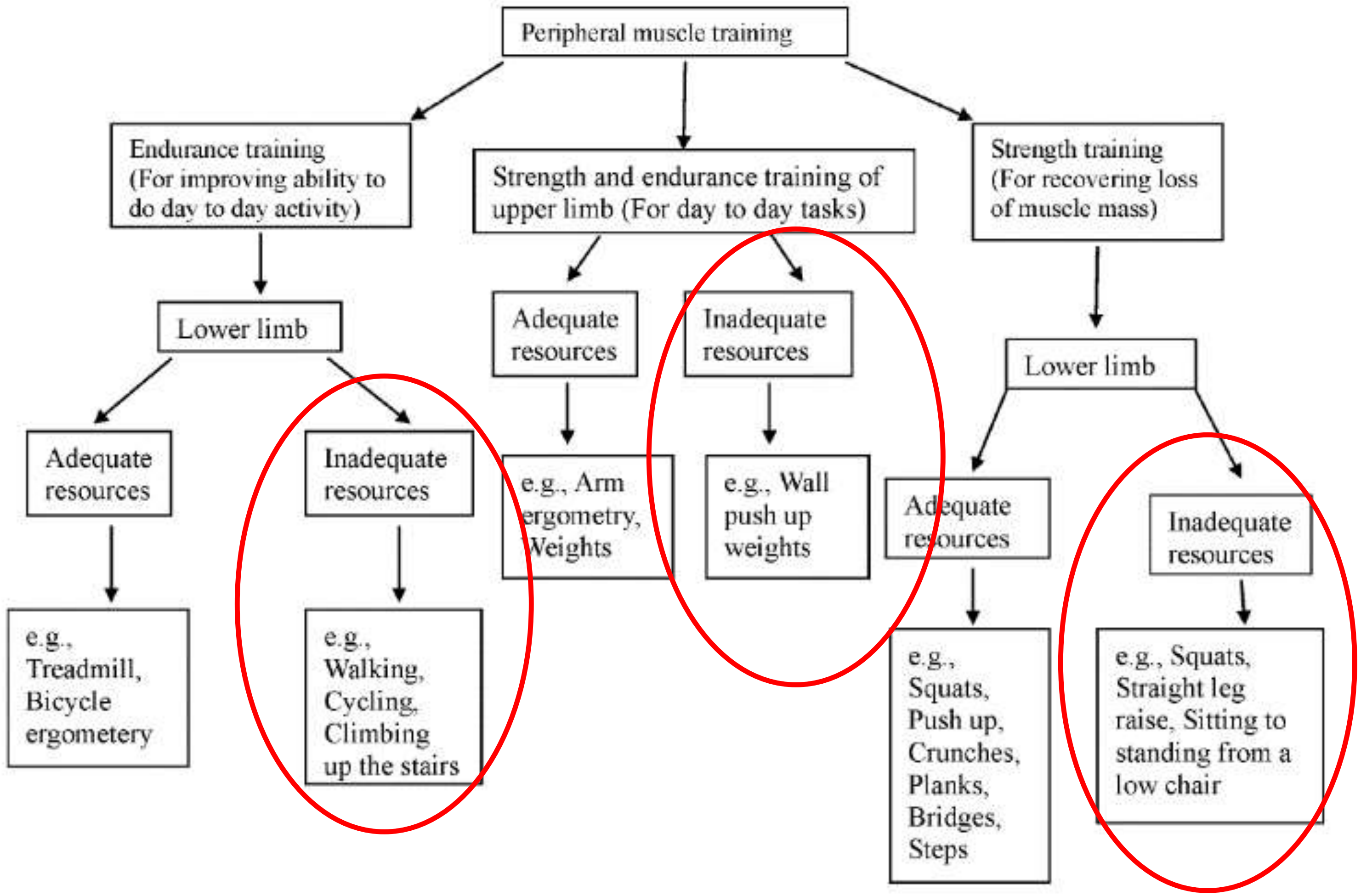
investigation and treatment on these selected components, it is hoped that patients with COPD might lead fuller and more satisfying lives. Antidepressants are helpful for psychological disturbances, bronchodilators and narcotics can help dyspnea, and pulmonary rehabilitation programs, which are a rarity in India, show functional improvement of the 6-minute walk. Improvements in peer groups and family support may benefit patients by providing more social structure.

Measures of perceived severity of illness (CLD) and dyspnea (MRC) likewise showed tight correlation with QOL

•International Journal of COPD 2012:7 291–296



•Indian J Chest Dis Allied Sci 2011;53:163-172

Steps of pulmonary rehabilitation in resource-poor settings

- Assess the patient with spirometry, saturation, 6MWT, weight
- Exercise training by a trained staff, or an assistant at the time of enrolment for 30 minutes
- The exercise should simulate the patient's home environment
- The endurance and strength training can be done by walking/ cycling, walking uphill/climbing stairs and straight leg raise, respectively
- The exercise should be guided by his ability to tolerate exercise and 6 MWT with periods of rest if desired. The speed and distance should be increased gradually
- The patients should exercise twice in a day for 30 minutes for at least 5 to 6 days in a week
- The patient may follow up once in a week or 15 days for reinforcement/increment/supervision of exercises

•**Indian J Chest Dis Allied Sci 2011;53:163-172**

Future directions

- EXPANDING THE APPLICABILITY OF PULMONARY REHABILITATION
    - Pulmonary Rehabilitation During Critical Illness
    - Pulmonary Rehabilitation in the Home and Community Settings
    - Technology-Assisted Pulmonary Rehabilitation
    - Pulmonary Rehabilitation for the Non-COPD Respiratory Patient

Future Directions

- FURTHER DEFINING THE EFFECTIVENESS OF PULMONARY REHABILITATION
  - Self-Management Education
  - Maintaining the Benefits of Pulmonary Rehabilitation

Future Directions

- PROMOTING ACCESSIBILITY TO PULMONARY REHABILITATION
    - Increasing the Awareness of Pulmonary Rehabilitation
    - Fair Reimbursement for Pulmonary Rehabilitation

ATS/ERS

- **A program of exercise training of the muscles of ambulation is recommended as a mandatory component of pulmonary rehabilitation for patients with COPD.**
- *Grade of Recommendation: 1A*

BTS

- Pulmonary rehabilitation should be offered to patients with chronic obstructive pulmonary disease (COPD) with a view to improving exercise capacity by a clinically important amount.
- (Grade A)

ATS/ERS

- **Pulmonary rehabilitation improves the symptom of dyspnea in patients with COPD.**
- *Grade of Recommendation: 1A*

BTS

- Pulmonary rehabilitation should be offered to patients with COPD with a view to improving dyspnoea and health status by a clinically important amount. (Grade A)

ATS/ERS

- **Pulmonary rehabilitation improves health related quality of life in patients with COPD.**
- *Grade of Recommendation: 1A*

BTS

ATS/ERS

- **Pulmonary rehabilitation reduces the number of hospital days and other measures of health-care utilization in patients with COPD**
- *Grade of Recommendation: 2B*

BTS

- a priori opted not to evaluate healthcare utilization costs.

ATS/ERS

- **Pulmonary rehabilitation is cost-effective in patients with COPD.**
- *Grade of Recommendation: 2C*

BTS

ATS/ERS

- **There is insufficient evidence to determine if pulmonary rehabilitation improves survival in patients with COPD. No recommendation is provided.**

BTS

ATS/ERS

- **There are psychosocial benefits from comprehensive pulmonary rehabilitation programs in patients with COPD.**
- *Grade of Recommendation: 2B*

BTS

- Pulmonary rehabilitation should be offered to patients with COPD with a view to improving psychological wellbeing.
- (Grade A)

ATS/ERS

- **Six to 12 weeks of pulmonary rehabilitation produces benefits in several outcomes that decline gradually over 12 to 18 months.**
- *(Grade of Recommendation: 1A)*

BTS

- Pulmonary rehabilitation programmes of 6–12 weeks are recommended. (Grade A)

ATS/ERS

- **Lower-extremity exercise training at higher exercise intensity produces greater physiologic benefits than lower-intensity training in patients with COPD.**
- *Grade of Recommendation: 1B*

BTS

- the relative merits of different components of training (eg. resistance vs aerobic; upper limb vs lower limb)
- unanswered

ATS/ERS

- **Current scientific evidence does not support the routine use of anabolic agents in pulmonary rehabilitation for patients with COPD.**
- *Grade of Recommendation: 2C*

BTS

- No specific hormonal or nutritional supplement can currently be recommended as a routine adjunct to pulmonary rehabilitation.
- (Grade B)

ATS/ERS

- **Unsupported endurance training of the upper extremities is beneficial in patients with COPD and should be included in pulmonary rehabilitation programs.**
- *Grade of Recommendation: 1A*

BTS

- the relative merits of different components of training (eg. resistance vs aerobic; upper limb vs lower limb)
- unanswered

ATS/ERS

- **The scientific evidence does not support the routine use of inspiratory muscle training as an essential component of pulmonary rehabilitation.**
- *Grade of Recommendation: 1B*

BTS

- Inspiratory muscle training (IMT) is not recommended as a routine adjunct to pulmonary rehabilitation. (Grade B)

ATS/ERS

- **Education should be an integral component of pulmonary rehabilitation. Education should include information on collaborative self-management and prevention and treatment of exacerbations.**
- *Grade of Recommendation: 1B*

BTS

ATS/ERS

- **There is insufficient evidence to support the routine use of nutritional supplementation in pulmonary rehabilitation of patients with COPD. No recommendation is provided.**

BTS

ATS/ERS

- **Pulmonary rehabilitation is beneficial for some patients with chronic respiratory diseases other than COPD**
- *Grade of Recommendation: 1B*

BTS

- General exercise should be encouraged for all patients with chronic respiratory disease. (√)

Take Home Message

- Evidence strongly support pulmonary rehabilitation, including at least four weeks of exercise training, as part of the spectrum of treatment for patients with COPD
- Pulmonary rehabilitation has long been underused in patients with COPD
- Additional RCTs comparing PR and conventional care in COPD are no longer warranted.

Take Home Message

- Factors that remain uncertain include the degree of supervision, the intensity of the training and how long the treatment effect persists.
- These specific issues demand further elucidation through RCTs and further meta-analysis

Take Home Message

- There is an urgent need to establish pulmonary rehabilitation programs in India and offer patients the benefit of same above the “usual care”