Pulmonary Rehabilitation in 2013
Evidence Based Guidelines
Tammy Wichman MD
Associate Professor of Medicine
Pulmonary Critical Care
Creighton University Medical Center

Faculty Disclosure

Tammy O. Wichman, MD

Dr. Wichman has listed no financial interest/arrangement that would be considered a conflict of interest. The conference planning committee has listed no financial interest/arrangement that would be considered a conflict of interest.
Ignatian Values

• “The Magis” This Latin word suggests that those who serve an Ignatian mission should be explicitly concerned for constant improvement.

Objectives

• Effectiveness of Pulmonary Rehabilitation in Terms of Clinically Important Outcomes
• Components of Pulmonary Rehabilitation Programs
• The Future

• Pulmonary Rehabilitation: Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines. Chest 2007;131;4-42
Pulmonary Rehabilitation
ATS and ERS Definition

• Evidence-based
• Multidisciplinary
• Comprehensive
• Individualized treatment
• Designed to reduce symptoms, optimize functional status, increase participation, and reduce health care costs through stabilizing or reversing systemic manifestations of the disease.
• Comprehensive pulmonary rehabilitation programs include patient assessment, exercise training, education, and psychosocial support.

The Dyspnea Spiral

Exercise Training in Pulmonary Rehabilitation Interrupts This Vicious Cycle

*Stay at home, depression, oxygen therapy, etc.
Adapted from Denis O’Donnell, MD
Targets of Exercise Training as Part of a Pulmonary Rehabilitation Program for Patients with COPD


The Joy of Exercise!
• 1st controlled trials on pulmonary rehabilitation in the 1970s
• Initial skepticism in the 1980s
• Many well-designed randomized controlled trials prove clinically significant improvements with pulmonary rehabilitation

World Health Organization

• Global Initiative for Chronic Obstructive Lung Disease (GOLD) consensus document:
• Pulmonary rehabilitation should be considered in patients with an FEV$_1$ below 80% of the predicted value
Most national and international guidelines for COPD consider pulmonary rehabilitation an important treatment option.

Every time I get the urge to exercise, I lie down until the feeling passes!

Goals of Pulmonary Rehabilitation

- Reduce symptoms
- Decrease disability
- Increase participation in physical and social activities
- Improve quality of life
- Maintain long-term benefits through changes in lifestyle
- Save health dollars

Effectiveness of Pulmonary Rehabilitation

- Symptoms
- Exercise performance
- Quality of Life
- Resource Utilization

My pulmonary rehab therapist told me to touch my toes. I said, “I don’t have that kind of relationship with my feet. Can I just wave?”

Outcomes of Pulmonary Rehab: Dyspnea

- 31 randomized controlled trials
- All showed an improvement in dyspnea during laboratory exercise and with ADLs
  - Measured by CRQ, VAS, TDI, SOBQ, Borg scale
- Pulmonary rehabilitation improves the symptom of dyspnea in patients with COPD.
- Strength of Evidence: 1A

Effectiveness of Pulmonary Rehabilitation: Exercise Performance

- In incremental tests, peak work rate improves on average by 18% compared with baseline
- Peak oxygen uptake improves by 11%
- Endurance exercise time improves by 87%
- 6 minute walk test improves by 49m
The addition of pulmonary rehabilitation to the treatment of patients with stable COPD results in more significant improvements in exercise tolerance than adding an additional bronchodilator.

Effect of home- or community-based (open circles), outpatient (solid circles), or inpatient (open square) pulmonary rehabilitation compared with usual care on health-related quality of life (HRQoL), expressed as a fraction of the minimal clinically important difference (MCID), and various medication trials with inhaled corticosteroids (+), long-acting bronchodilators (*), or combinations (open triangles). AJRCCM 2005;172:19-38
Effectiveness of Pulmonary Rehabilitation: Health-related Quality of Life

- Pulmonary rehabilitation clearly exceeds the minimal clinically important difference.
Measurement of Quality of Life in the National Emphysema Treatment Trial
Chest 2004; 126:781-9

- Randomized controlled multicenter clinical trial designed to compare lung volume reduction surgery to medical therapy
- All patients participated in pulmonary rehabilitation prior to randomization
- 1218 patients (746 male)  Average age 67
- FEV₁ 0.29-1.58
- 16-20 sessions over 6-10 weeks
- QOL measures completed during clinic visit prior to initiation of rehabilitation and again after completion of rehab
- Significant improvements on all QOL measures Correlated with change in 6 min walk distance

National Institutes of Health National Emphysema Treatment Trial (NETT)

- When, despite pulmonary rehabilitation, patients still have severely impaired exercise capacity and have predominantly upper lobe emphysema, they are likely to benefit from LVRS
Effectiveness of pulmonary rehabilitation: Health Care Utilization

- Pulmonary rehabilitation has reduced the number of hospitalizations and the number of days of hospitalizations in patients with COPD
- Strength of Evidence: 2B
- Pulmonary rehabilitation is cost-effective in patients with COPD
- Strength of Evidence: 2C

Effectiveness of pulmonary rehabilitation: Health Care Utilization
Lancet 2000;355:362-8

- Randomized controlled trial
- 200 patients with COPD were randomized to
  - 6-week multidisciplinary out-patient rehabilitation program
  - Standard medical management
- Assessments were performed at baseline, after the 6-week program, and at 1 year
Study Results

• The rehabilitation group spent fewer days in the hospital compared with the control group
• Rehabilitation group showed greater improvements in walking ability (shuttle walk test) and health status (SGRQ and CRDQ)
• Differences, though smaller, remained significant after 1 year

SGRQ = St. George’s Respiratory Questionnaire; CRDQ = Chronic Respiratory Disease Questionnaire.

Pulmonary Rehabilitation and Days Spent in Hospital

$P = .021$.
A Simple Pulmonary Rehabilitation Program Improves Health Outcomes and Reduces Hospital Utilization in Patients with COPD
Chest 2003;124:94-97

- 36 patients enrolled in pulmonary rehab program
- Mean age 69
- FEV₁ 43% predicted
- Significant increase in 6 minute walk distance
- Hospital utilization compared in 12 months prior and 12 months following completion of pulmonary rehab: hospital admission fell from 1.2 to 0.6 episodes per patient per year (p < 0.005) and mean length of stay fell from 7.4 days to 3.3 days (p < 0.01)

Effects of Pulmonary Rehabilitation on Dyspnea, Quality of Life, and Healthcare Costs in California
J of Cardiopulmonary Rehab 2004;24:52-62

- Observational study: 10 pulmonary rehab programs collected health outcome data over 2 years
- 415 patients
- Mean age 68 42% male
- FEV₁ 44% predicted
- 2-3 sessions per week for 6-8 weeks

- After rehab, there were significant improvements in symptoms and quality of life as measured by SOBQ.
- There were significant declines in healthcare utilization (physician visits, calls, hospital days, and urgent care visits)
Cochrane meta-analysis

- 5 RCTs
- PR following AECOPD reduced hospital admissions with an odds ratio of 0.22 (95% CI: 0.08-0.58) and NNT 4
Survival

- Multiple studies assessed effect of pulmonary rehab on survival but only two were randomized, controlled
- Ries: 119 patients with COPD
- Survival at 6 years was slightly better (67% vs 56% p=0.32)
- Griffiths: 200 patients with COPD
- Over 1 year: 6/99 deaths in rehab group vs 12/101 in controls
- There is insufficient evidence to determine whether pulmonary rehabilitation improves survival in patients with COPD. No recommendation is provided.

Effectiveness of Pulmonary Rehabilitation in Stable COPD Patients: Survival

- When studies are pooled, 1-year mortality risk was 7.8% in the rehabilitation group (23/315) and 9.9% in the control group (28/283).
- Pooled odds of dying in the rehabilitation group, as compared with the control group was 0.69
- Rehabilitation reduces the short term risk of dying by 31%
- Need a large-scale RCT with a prolonged follow up
Pulmonary Rehab after Acute Exacerbation of COPD: Mortality

- 9 trials 432 patients
- Significant reduction in the odds of death with early PR after hospitalization (OR 0.28; 95% CI 0.1-0.84) NNT 6

“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”
Effectiveness of Pulmonary Rehabilitation: Survival

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Key components of pulmonary rehabilitation

• Exercise Training
• Education
• Psychosocial Support
• Occupational Therapy
• Nutrition
Design for Exercise Training Programs

• In healthy subjects, cardiorespiratory fitness improves when exercises are performed
  – 3 to 5 days per week
  – at an intensity above 40-85% of the oxygen uptake reserve
  – for more than 20 minutes continuously or in intervals
• Exercise training at higher intensity produces greater physiologic benefits than lower intensity training. 1B
  – Exercise intensity targets 60-80% of the peak work
• Both low intensity and high intensity exercise training produce clinical benefits. 1A

Interval Training

• Some patients have problems achieving the target training intensity for 20-30 min
• 30 minute exercise is divided into smaller exercise bouts with appropriate intensity (70-100% of peak work rate).
  – 30 seconds to 2-3 minutes
• Higher work rates with lower symptom scores
• Total exercise time of 30 minute
Rehab therapists should be given the latitude to adjust these targets up or down depending on the patient’s symptomatic response.

- Close supervision of the patients is needed.
- Weekly increments of training intensity are possible
  - Borg Rating of Perceived Exertion Scale: 4-6
Exercise training duration

- Six to 12 weeks of pulmonary rehabilitation produces benefits that decline gradually over 12-18 months. 1A
- HRQoL remains above controls at 12-18 months 1C
- Pulmonary rehabilitation programs of longer duration (6 months) have shown better long-term effects as compared with shorter interventions 2C
Resistance arm training in patients with COPD: A RCT

- 36 patients with COPD
- Arm resistance training 3 x a week for 6 weeks
- Improved arm function, exercise capacity and muscle strength
- No improvement in dyspnea, HRQL, or symptoms
- Janaudis-Ferreira et al. Chest 2011; 139(1)151-8

Upper Extremity Training

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

- Training small muscle groups alleviates the ventilatory burden of exercise training
- Training volume: the number of repetitions and the weight lifted (as a fraction of the maximum weight that can be lifted once)
  - 2-3 sets of 8 repetitions at 70% of max weight
- Currently used in combination with endurance training
- The addition of a strength training component increases muscle strength and mass 1A

Respiratory Muscle Training

- Specifically targeting respiratory muscles has been studied using resistive breathing with target inspiratory pressures or flows or with threshold loading devices
- Consistently leads to reductions in dyspnea and improved measures of inspiratory muscle performance
- Relatively inexpensive, but require regular supervision
- No improvement in exercise tolerance or quality of life
- Evidence based guidelines: should not be a routine component 1B
Transcutaneous Electrical Muscle Stimulation

- Confers gains in muscle function and exercise capacity
- Bourjeily-Habr et al. stimulated quadriceps, hamstring, and calf muscles and improved distance in 6min walk
- Neder et al stimulated quadriceps and showed increase in muscle strength, peak VO2, and cycle exercise endurance

Thorax 2002;57(12):1045-49
Thorax 2002;57(4):333-337

Education

- Up to 75% of patients have difficulties in understanding how and when to take their inhalation medication
- Action plans to deal with exacerbations may be of benefit
### Education

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

### Psychosocial Support

- Incidence of depression in patients with COPD is 2.5 x higher than the general population
- There is minimal evidence to support the benefits of psychosocial intervention as a single therapeutic modality 2C
- Although scientific evidence is lacking, expert opinion supports the inclusion of psychosocial interventions as a component of comprehensive pulmonary rehabilitation programs
Smoking cessation

- Smokers are more likely to decline invitations to participate in rehabilitation
- Generally less adherent than ex-smokers
- Smoking cessation should **NOT** be a pre-requisite
- Smoking cessation:
  - Counseling
  - Education
  - Nicotine replacement
  - Antidepressants
Improving Activities of Daily Living

- Occupational therapy interventions showed significant benefits on reported activities of daily living
  - Functional training in ADLs
  - Energy-conserving strategies
  - Use of wheeled walking aids

Nutritional Interventions

- Loss of fat-free mass is closely related to morbidity and mortality in COPD patients
- Nutritional specialists should balance caloric intake of patients with the energy requirements
  - Patients with COPD have increased resting energy expenditure compared with age-matched subjects
- There is insufficient evidence to support routine use of nutritional supplementation in pulmonary rehabilitation.
Evaluation Before, During, and After Pulmonary Rehabilitation

- Strong evidence is not available regarding which tests are essential to pulmonary rehabilitation
- 1. Ensure patient safety: maximal ergometry with gas exchange and EKG monitoring before starting program
- 2. Multidisciplinary assessment of patients including motivation
- 3. Assessment of disease severity
• A maximal exercise test is recommended to assess safety of exercise and the factors contributing to exercise limitation
• Pulmonary Function Testing
• Skeletal muscle strength tests and assessment of inspiratory muscles may be helpful
• Standardized questionnaires to assess psychosocial problems or limitations in activities of daily living
• Data on body composition and fat-free mass from bioelectrical impedance

Assessing Program Outcome

• Exercise tolerance:
  – 6 minute walking distance
  – Shuttle walking test
  – Submaximal constant work rate test
• Health related quality of life: Chronic Respiratory Disease Questionnaire and St. George’s Respiratory Questionnaire
Adjunctive Therapies: Oxygen supplementation

- Oxygen reduces ventilatory requirements and dyspnea
  - even in patients without appreciable exercise desaturation
  - oxygen delivery to the exercising muscles is enhanced
- No difference in VO2 max, 6 minute walk or HRQOL
- Oxygen reduces exercise-induced pulmonary hypertension in moderate to severe COPD
- Supplemental oxygen should be used during exercise training in patients with exercise induced hypoxemia 1C
- Administering supplemental oxygen during high-intensity exercise programs in patients without exercise induced hypoxemia may improve gains in exercise endurance 2C

Noninvasive mechanical ventilation

- CPAP, Bilevel, or proportional assist ventilation unloads the respiratory muscles
- Improves dyspnea and exercise endurance in patients with COPD
  - inconsistent
- Blood gases improve and patients are able to sustain lactic acid accumulation for a longer period of time
- 2 trials showed enhanced training intensity in severely impaired hypercapnic COPD patients but not confirmed in patients with less severe disease
- As an adjunct to exercise training in selected patients with COPD, noninvasive ventilation produces modest additional improvements in exercise performance. 2B
- $, technically difficult
Helium-Oxygen Breathing

- Breathing gas mixtures with low density lowers airflow resistance and decreases exercise-induced hyperinflation.
- 1 trial showed greater gains in cycle exercise endurance (9 min vs 4 min)
- Another study did not improve peak exercise capacity or endurance
- $, awkward to administer, not available at home

Breathing Exercises

- Benefit unclear
- Pursed-lip breathing:
  - recruitment of the abdominal muscles during expiration
  - pulmonary gas exchange is improved
  - tidal volume is increased, reducing the ratio of inspiratory time to the total duration of the respiratory cycle and
  - reduces dyspnea
Ergogenic drugs: Growth hormone/insulin-like growth factors and anabolic steroids

- Oxandrolone, nandrolone decanoate, stanozolol, and testosterone
- All studies show an increase in body weight through a gain in lean body mass
- Anabolic steroids increase muscle strength but do not improve exercise endurance
- Testosterone may help prevent corticosteroid-induced myopathy
- Human growth hormone failed to show an improvement in skeletal muscle force or exercise capacity
- Current scientific evidence does not support the routine use of anabolic agents in pulmonary rehabilitation 2C

Where to Organize Rehabilitation Programs

- Inpatient $$
- Outpatient
- Home-based: less $ but less successful
Effect of aerobic exercise training in patients with pulmonary arterial hypertension

- Weinstein et al. Respiratory Medicine 2013
  http://dx.doi.org/110.1016
- 24 female patients with PAH
- Education vs education plus aerobic exercise
- Increased physical activity and decreased fatigue

What is on the Horizon? Future Research

- Need more research to investigate how long programs should be and how frequently sessions should be held to result in maximal effects
- More appropriate strategies to maintain training effects as long as possible
  - Telemedicine
- Nutritional interventions
- Antioxidant therapy
- Pulmonary rehabilitation for other diseases
The Bottom Line

- Pulmonary rehabilitation has been proven to have clinical benefits for dyspnea, exercise tolerance, health care utilization, and quality of life.