THE EVOLVING ROLE OF REHABILITATION IN COPD*

Andrew L. Ries, MD, MPH†

ABSTRACT

A strong, growing, scientifically sound evidence base supports the benefits of pulmonary rehabilitation for patients with chronic obstructive pulmonary disease (COPD). In the past 10 years, nearly 1000 new articles have been added to the medical literature on this topic. This literature was reviewed systematically by an expert panel for the American College of Chest Physicians and the American Association of Cardiovascular and Pulmonary Rehabilitation, which published revised evidence-based guidelines for pulmonary rehabilitation in COPD. This article reviews selected recommendations from these guidelines, with a focus on cost-effectiveness, exacerbations/hospitalizations, and maintenance. Additional research is needed to determine how to integrate pulmonary rehabilitation principles into a chronic disease management model.


---

**PROCEEDINGS**

**THE EVOLVING ROLE OF REHABILITATION IN COPD**

Andrew L. Ries, MD, MPH†

---

*Based on a presentation by Dr Ries at a roundtable held in Baltimore, Maryland, on September 26, 2008.

†Associate Dean for Academic Affairs, Professor of Medicine and Family and Preventive Medicine, University of California, San Diego, San Diego, California.

Address correspondence to: Andrew L. Ries, MD, MPH, Associate Dean for Academic Affairs, Professor of Medicine and Family and Preventive Medicine, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093. E-mail: aries@ucsd.edu.
WHO CAN BENEFIT?

In addition to treatment of COPD, pulmonary rehabilitation programs can benefit patients with other chronic lung conditions, such as restrictive and other obstructive lung diseases. It has also been used successfully in patients undergoing lung volume reduction surgery or transplant. Pulmonary rehabilitation is appropriate for stable, motivated, symptomatic patients with chronic lung disease with recognized disability, provided that realistic goals are established.

A variety of rehabilitation strategies are used in pulmonary rehabilitation. Program components typically include an initial evaluation, patient education, instruction in respiratory and chest physiotherapy techniques, psychosocial support, and exercise. The goal of pulmonary rehabilitation is to restore the patient to the highest level of independent function by mitigating the degree of disability, as opposed to changing the disease process itself. This is accomplished by targeting specific aims, such as increasing activities of daily living, exercise tolerance, and independence, which in turn can help to reduce not only symptoms, but also healthcare utilization and overall costs.

UPDATED EVIDENCE-BASED GUIDELINES

In 2007, evidence-based guidelines published previously in 1997 by the ACCP and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) were updated based on a systematic review of nearly 1000 new publications in the pulmonary rehabilitation literature over the past decade. After reviewing the literature, an expert panel developed recommendations and graded them as either strong (Grade 1) or weak (Grade 2). When the panel was certain that a recommendation’s benefits outweighed the risk (or vice versa), it was graded as strong. If the panel was less certain or considered the benefits and risks to be equally balanced, the resulting recommendation was weak. Strength of evidence was rated from high (Grade A) to low (Grade C). The guidelines reported on multiple outcomes and components of comprehensive pulmonary rehabilitation, including lower and upper extremity exercise, dyspnea, health-related quality of life (HRQOL), healthcare utilization, cost-effectiveness, and psychosocial benefits. The limited scope of this article prohibits reporting on all of these areas but instead focuses on selected domains.

COST-EFFECTIVENESS, HOSPITALIZATIONS, AND ACUTE EXACERBATIONS

According to the ACCP/AACVPR guidelines, pulmonary rehabilitation: (1) reduces the number of hospital days and other measures of healthcare utilization in patients with COPD (Grade 2B); and (2) is cost effective in patients with COPD (Grade 2C). A novel study supporting this recommendation was a multicenter, randomized-controlled trial of a self-management program for 191 patients with severe COPD reported by Bourbeau et al. Compared to controls, the intervention group demonstrated 40% fewer hospitalizations from acute exacerbations of COPD (AECOPD) and 57% reduction in hospitalizations attributable to other causes over a 12-month period (Table). Unscheduled physician visits decreased by 59% ($P = .003$). This study demonstrated that an outpatient program, undertaken primarily in the homes of patients by trained health professionals, can significantly reduce the utilization of healthcare services and improve health status.

Questions remain in pulmonary rehabilitation as to the appropriate duration of treatment and timing of follow-up interventions. In a trial reported by Foglio et al., 61 patients with COPD were studied 1 year after completing an initial 8-week outpatient pulmonary rehabilitation program. One group was randomized to undergo a second program and the second group was not. Hospitalizations and exacerbations per patient decreased significantly in both groups over 2 years following the first round of rehabilitation, when compared to the prior years. Nevertheless, at the 24-month follow-up visit, a further reduction in exacerbations...
was observed only in the group that underwent the second pulmonary rehabilitation after the first year.

In a small study of pulmonary rehabilitation following hospitalization for COPD exacerbation, Man et al.\(^1\) reported 77\% fewer emergency visits and a trend toward reduced hospital admissions 3 months following discharge in the intervention group as compared to the usual care group. A large observational study\(^1\) of 522 patients who underwent pulmonary rehabilitation in centers throughout California reported 60\% fewer hospital days and 40\% fewer urgent care visits over 18 months following the program. Although an initial study by Griffiths et al.\(^1\) found no differences in hospital admission rates between an intervention and control groups 1 year after pulmonary rehabilitation, a subsequent economic analysis\(^1\) reported benefits in terms of cost per quality-adjusted life-years gained.

A cost analysis of a controlled trial of 84 patients with COPD randomized to receive a 2-month inpatient pulmonary rehabilitation program followed by 4 months of outpatient supervision reported savings ranging from $19,011 to $35,142 (Canadian dollars) per unit improvement in component measures of the Chronic Respiratory Disease Questionnaire.\(^1\) Although these cost efficiencies were associated with inpatient care, they support the value of pulmonary rehabilitation demonstrated in the outpatient studies described previously.

Acute exacerbations of COPD represent a major financial burden for healthcare systems. There is some evidence that pulmonary rehabilitation after AECOPD reduces hospitalizations and may reduce mortality. A systematic review\(^1\) of randomized-controlled trials in this area showed a consistently favorable effect on quality of life. Figure 1 shows the effect of pulmonary rehabilitation on unplanned hospital admissions for each study.\(^1,11,17,18\) Across studies, rehabilitation reduced the risk for hospital admissions (pooled relative risk = 0.26 [0.12–0.54]).\(^1\) Across studies, the pooled risk ratio for mortality was 0.45 (0.22–0.91),\(^1\) suggesting that pulmonary rehabilitation after hospitalization for AECOPD may also improve survival (Figure 2).\(^1,17,19\)

### Supplemental Oxygen with Exercise

It is well known that some patients with chronic lung disease can develop worsening hypoxemia with exercise. Given the profound benefits of exercise in the COPD population, supplemental oxygen during exercise is recommended to help maintain adequate oxygenation during activities. Figure 2 shows the effect of rehabilitation after AECOPD on mortality.

---

**Figure 1. Effect of Rehabilitation After AECOPD on Hospital Admission**

- **Study:** (n Rehabilitation/Usual Care Group)
- **Length of Follow-Up:**
  - Babkina\(^2\) (14/12) 18 mo
  - Man\(^1\) (20/21) 3 mo
  - Murphy\(^1\) (13/13) 6 mo
  - Overall (47/46)
- **Risk Ratio (95\% CI):**
  - Babkina: 0.29 (0.1–0.82)
  - Man: 0.17 (0.04–0.68)
  - Murphy: 0.29 (0.09–1.7)
  - Overall: 0.28 (0.13–0.56)
- **Weight in %:**
  - Babkina: 37\%
  - Man: 44\%
  - Murphy: 19\%
  - Overall: 7\%

**Figure 2. Effect of Rehabilitation After AECOPD on Mortality**

- **Study:** (n Rehabilitation/Usual Care Group)
- **Length of Follow-Up:**
  - Babkina\(^2\) (14/12) 18 mo
  - Man\(^1\) (20/21) 3 mo
  - Troosters\(^2\) (24/19) 48 mo
  - Overall (58/52)
- **Risk Ratio (95\% CI):**
  - Babkina: 1 (0.07–15.04)
  - Man: 0.5 (0.05–5.1)
  - Troosters: 0.45 (0.22–0.91)
  - Overall: 0.45 (0.22–0.91)
- **Weight in %:**
  - Babkina: 6.6\%
  - Man: 9.3\%
  - Troosters: 83.9\%
  - Overall: 8.4\%

Boxes with 95% confidence intervals represent point estimates for the risk. AECOPD = acute exacerbations of chronic obstructive pulmonary disease.

Reprinted with permission from Puhan et al. *Respir Res*. 2005;6:54.\(^1\)

---
rehabilitative exercise is generally recommended for patients with severe exercise-induced hypoxemia (Grade 1C). From a safety perspective, there is a strong rationale for oxygen supplementation during exercise for patients with exercise-induced hypoxemia. There is also some equivocal evidence to support use of supplemental oxygen even in patients without exercise-induced hypoxemia during high-intensity exercise programs in order to improve exercise endurance (Grade 2C). The medical literature shows acutely improved exercise tolerance with oxygen supplementation in this population, but variable results for longer-term exercise training in pulmonary rehabilitation.

**MAINTENANCE STRATEGIES FOR PULMONARY REHABILITATION**

The optimal duration of pulmonary rehabilitation is unclear. Available evidence suggests that 6 to 12 weeks of pulmonary rehabilitation produces benefits in several outcomes, but these benefits decline gradually over 12 to 18 months (Grade 1A). Some benefits, such as HRQOL, remain above control levels at 12 to 18 months (Grade 1C). Existing data suggest that gains in exercise tolerance may be greater following longer programs. Strategies for maintaining the benefits of pulmonary rehabilitation over time, such as repeat programs or maintenance interventions, have been studied. Overall, maintenance strategies following pulmonary rehabilitation have a modest effect on long-term outcomes (Grade 2C).

Our recent study of 160 patients with chronic lung disease demonstrated that a 12-month maintenance intervention consisting of weekly telephone contacts, monthly supervised exercise, and educational reinforcement led to modest improvements in exercise tolerance and health status for 12 months following the initial rehabilitation program. However, the gains from both rehabilitation and follow-up interventions gradually declined over 2 years.

Why do maintenance strategies only modestly affect long-term outcomes? It is important to recognize that rehabilitation with behavioral interventions in a chronic disease model is very different from behavioral modification in healthier individuals. Although sustaining motivation and behavioral change is problematic in any setting, in patients with chronic lung disease the situation is more complex because the reason patients stop exercising and lose benefits from pulmonary rehabilitation is that, often, they get sick and require hospitalization. Afterwards, they are incapable of resuming their former activity level. Physiologic changes associated with age and disease progression also interfere. It is unreasonable to expect patients to maintain rehabilitative benefits long-term without reevaluating their status. The acute care model is not well suited for chronic disease. Chronic problems require chronic treatment and adjustments to the therapeutic plan. Patients need reevaluation and continued management.

**CONCLUSIONS**

There exists a strong, growing, scientifically sound evidence base supporting the benefits of pulmonary rehabilitation for patients with COPD, mostly conducted in stable outpatients. Despite the relatively low cost and favorable risk/benefit ratio, pulmonary rehabilitation is underutilized and not widely available. Evidence suggests that the high costs for COPD can be reduced with pulmonary rehabilitation as a result of reduced hospitalizations, and that mortality rates may also decrease. These findings have prompted health plans and insurers, increasingly, to support pulmonary rehabilitation as part of the therapeutic continuum for patients with COPD. Furthermore, in July of 2008, Congress passed legislation directing Medicare to establish a coverage benefit for pulmonary rehabilitation, a lead that payers across the nation will likely follow. More work is needed, however, to maintain and extend rehabilitative interventions and to make these services more accessible to patients in dispersed geographic regions. Additional research is needed to determine how to integrate pulmonary rehabilitation principles into a chronic disease management model.

**DISCUSSION**

**Dr Make:** Once pulmonary rehabilitation becomes better funded, are there standards for certification of centers to help safeguard appropriate patient care?

**Dr Ries:** The AACVPR has developed a certification process. Many programs are pursuing certification in anticipation of a government-legislated policy requiring it.

**Dr Rand:** Do you anticipate that COPD will fit into a model for general chronic disease management?
Many of the services and supports in place for managing chronic diabetes, for example, or congestive heart failure are broad-based and apply to COPD management as well. There are more similarities between them than differences, particularly in terms of behavioral management. Is there merit to exchanging a turf-oriented approach to disease management for a collaborative model?

**Dr Ries:** I think that is critical. What we tend to do in pulmonary rehabilitation is use a very defined, limited model for a very small number of patients who have moderate-to-severe disease. But that is really only the tip of the iceberg of the COPD population. I agree that there are chronic care models we need to actively pursue, particularly in light of the many COPD comorbidities. Clinicians should be able to stratify patients across the spectrum of chronic lung disease and design appropriate interventions for each stage of the rehabilitation spectrum. We need to rethink how we do things in a broader context.

**Dr Rand:** From that vantage point, isn’t the phrase pulmonary rehabilitation a misnomer?

**Dr Ries:** There is probably a better term than “rehab” for what we are attempting to accomplish. Integrated care is one conceptual model that embraces rehabilitation principles in a much broader context. AACVPR has adopted a much more prevention-oriented approach and has undergone a name change to integrate cardiovascular care with its historical pulmonary model.

**Dr Wise:** Pulmonary rehabilitation differs from other forms of rehabilitation, however, in that you have to push patients to a harder level where they are panting and short of breath. You would never ask cardiac patients to exert themselves to that extent. There is a specific skill needed, based on experience, for working effectively with pulmonary patients.

**Dr Ries:** Actually the principles of cardiac rehabilitation and pulmonary rehabilitation are very similar, but the patients are very different. That is why there is some danger to expanding cardiac rehabilitation centers to include pulmonary rehabilitation. You cannot use the same cues for exercise performance and sub-maximal tolerance in patients with COPD as are used in cardiac patients. And using a cardiac monitor on a severe, chronic lung patient will only frighten them, potentially preventing them from accomplishing rehabilitation goals.

### REFERENCES


