9 Exercise as Medicine

INTRODUCTION

Exercise training is a fundamental core component of comprehensive pulmonary rehabilitation programs. It confers multiple physiological and psychosocial benefits, including reduction of exertional dyspnea, enhancement of skeletal muscle strength, improvement of cardiopulmonary endurance, and overall health-related quality of life. Regular exercise mitigates physical deconditioning, optimizes ventilatory mechanics, and disrupts the self-perpetuating "dyspnea spiral" commonly observed in individuals with chronic respiratory disease.

EXERCISE TRAINING

Benefits in Chronic Respiratory Disease (CRD) Patients

- Improved aerobic capacity and muscle strength and endurance.
- Reduced exertional dyspnea and fatigue.
- Improved psychological well-being (reduced anxiety/depression symptoms).
- Reduced frequency of exacerbations and hospitalizations.

Framework and Guidelines for Prescription

The therapeutic benefits of exercise within PR can be maximized through rigorous safety monitoring, objective goal-setting informed by standardized exercise testing, strategic program planning, and individualized adaptations. Application of the FITT (Frequency, Intensity, Time, Type) principle provides a structured framework for exercise

prescription (Table 9.1). Careful planning of the following elements can enhance patient outcomes while minimizing adverse events (Table 9.2):

- **Individualized progression:**
  - Initiate exercise at the patient's baseline capacity, as determined by standardized assessments such as the six-minute walk test (6MWT).
  - Increase exercise duration and/or intensity by 5–10% every 1–2 weeks, based on patient tolerance.
  - Use the Borg rating of perceived exertion (targeting scores of 4–6) and continuous SpO_2 monitoring to guide progression and ensure safety.

TABLE 9.1: FITT principle for patients with COPD

Component	Recommendation
Frequency	3–5 sessions/week for 4–12 weeks
Intensity	Moderate to vigorous (e.g., 60–80% peak work rate, 4–6 on modified Borg scale)
Time	20–60 minutes/session, with rest breaks or intervals if needed
Type	Walking, stationary cycling, stair climbing, arm ergometry*

* Interval training is ideal for patients unable to tolerate continuous exertion due to dyspnea or fatigue.

TABLE 9.2: Exercise guidelines for non-COPD conditions

Condition	Type/intensity	Notes
Asthma	Moderate aerobic exercise at 40–60% heart rate reserve (HRR), progress to 60–80% HRR	Use bronchodilators prior to exercise; warm-up is recommended at the beginning of the exercise session.
ILD	Aerobic exercise with O_2 support (based on 6MWT)	Maintain SpO_2 >88%, focus on energy conservation.
PAH	Light-moderate aerobic exercise only	Avoid Valsalva maneuver, maintain SpO_2 >88%, high-resistance work is not recommended.
Post-COVID	Symptom-controlled aerobic and resistance exercise	Begin after clinical stability is achieved and gradually increase load of exercise.

- Alternate between aerobic and resistance training modalities to facilitate adequate recovery and prevent training monotony.

- **Goal setting and motivation:**
  - Set short-term goals (e.g., walking 10 minutes without rest) and long-term goals (e.g., improved QoL) in discussion with patient.
  - Involve patients in shared decision-making to build ownership and feeling of achievement.
  - Use visual tracking (progress charts, 6MWT gains) to boost patient morale.
- **Supervision and safety:**
  - **Professional supervision:** Exercise sessions should be overseen by healthcare professionals with specialized training in PR and proficient in cardiopulmonary resuscitation and emergency response protocols, particularly for high-risk groups such as patients with ILD, PH, or advanced age.
  - **Presession screening:** Prior to each session, a systematic assessment of blood pressure, heart rate, peripheral oxygen saturation (SpO_2) should be conducted.
  - **Emergency preparedness:** Facilities should maintain immediate access to emergency equipment (e.g., crash trolleys, supplemental oxygen) and have established protocols for rapid response, especially in inpatient or healthcare institution settings.
- **Incorporating recovery techniques:**
  - **Active recovery:** Integrate structured active cool-down routines, breathing control exercises, and flexibility or stretching activities following each exercise session to facilitate physiological recovery and reduce postexercise complications.
  - **Interval training:** For individuals with pronounced dyspnea or significant deconditioning, use interval-based protocols (e.g., 1 minute work:1 minute rest) to optimize exercise tolerance and minimize fatigue.
- **Tools that enhance adherence:**
  - **Activity monitoring:** Pedometers, mobile applications or telehealth platforms can be used to objectively monitor physical activity, thereby promoting adherence and consistency in exercise routines.
  - **Social support:** Encourage involvement of family members or peer groups to provide emotional support and accountability.

- **Regular follow-up:** Implement weekly follow-up *via* phone or text messaging to sustain patient engagement and support adherence beyond supervised, center-based session.

SUMMARY

- The FITT principle forms the foundation of exercise prescription in pulmonary rehabilitation.
- Evidence-based guidelines are most robust for chronic obstructive pulmonary disease (COPD), but tailored adaptations for other chronic respiratory diseases are increasingly supported by emerging data.
- Patient-centered, individualized programming, rigorous symptom monitoring, and professional supervision are critical to the safe and effective delivery of pulmonary rehabilitation.

10 Strengthening the Muscles to Breathe Better

INTRODUCTION

Patients with chronic respiratory diseases (CRDs) frequently experience limitations in physical activity due to dyspnea, reduced exercise tolerance, and associated skeletal muscle dysfunction. Physical deconditioning further increases ventilatory requirements during exertion, which can be effectively managed through the incorporation of resistance (strength) training. Although endurance training remains the cornerstone of pulmonary rehabilitation, the addition of resistance training has been shown to yield superior gains in muscle strength, endurance, and mass, often with reduced levels of exertional dyspnea.

STRENGTH TRAINING

Principles

The foundational principles of resistance training in this population include:

- **Progressive overload:** Exercise intensity and volume should be systematically increased beyond the patient's habitual activity level to stimulate muscular adaptation.
- **Specificity:** Training regimens should be tailored to target muscle groups and movement patterns relevant to the patient's functional deficits and daily activities.
- **Individualization:** Exercise prescriptions must be customized according to each patient's baseline capacity, clinical status, and progression, with regular adjustments based on tolerance and response.

TABLE 10.1: Strength training recommendations from global guidelines

Source	Frequency	Intensity	Key notes
ACSM	≥2 days/week	40–70% of 1 repetition maximum (RM), progressing to 60–70% of 1 RM	1–4 sets of 10–15 repetitions, rating of perceived exertion (RPE) 5–8, proper breathing and form.
ATS/ERS	2–3 days/week	60–70% 1 RM or 100% of 8–12 RM	Progress when >2 extra repetitions possible in 2 sessions.
AACVPR	2–3 days/week	Individualized *via* RPE	Functional focus, body weight and elastic resistance acceptable.
BTS	2–3 days/week	10–15 repetitions for 2–4 sets	Emphasis on quadriceps; 48 hours rest between sessions.

Optimal outcomes are achieved when resistance training is integrated with appropriate pharmacological management and nutritional support. Emphasis should be placed on functional, task-oriented movements that replicate activities of daily living (ADLs), thereby enhancing real-world physical performance. Strength training recommendations from global guidelines are summarized in Table 10.1.

Focus Areas

Lower Limb Training

Emphasis is placed on strengthening the quadriceps, which serve as a key indicator of overall systemic health in patients with CRD. Lower limb resistance training has been demonstrated to enhance performance in ADLs, sit-to-stand transitions, and walking endurance.

Upper Limb Training

Resistance exercises should target major upper limb muscle groups, including the biceps, triceps, deltoids, and latissimus dorsi. Enhanced upper limb strength is associated with greater independence in ADLs and self-care.

Alternative Modalities

Inspiratory Muscle Training

Inspiratory muscle training (IMT) is specifically recommended for individuals exhibiting significant inspiratory muscle weakness, such as those with neuromuscular disorders or following acute exacerbations of respiratory disease. Evidence demonstrates that IMT enhances inspiratory muscle strength and endurance, reduces dyspnea, and improves exercise tolerance.

Neuromuscular Electrical Stimulation (NMES)

Neuromuscular electrical stimulation (NMES) serves as an effective intervention for severely deconditioned patients who are unable to participate actively in conventional exercise programs, facilitating muscle activation and strength gains.

Water-Based Training

Aquatic exercise offers the advantage of reduced joint loading. The hydrostatic pressure of water can also enhance expiratory function and support ventilatory mechanics during exercise.

Benefits

- Enhanced performance in ADLs and increased muscle endurance.
- Reduced ventilatory demand and alleviation of dyspnea.
- Improved functional exercise capacity.
- Lower risk of falls, particularly in elderly populations.
- Better overall quality of life.

SUMMARY

Strength training is an essential element of PR, and should be individualized and progressed based on patient-specific requirements and objective strength assessments. When combined with endurance training, strength interventions confer additional benefits for patients with CRD. International guidelines from organizations such as the ACSM, ATS/ERS, AACVPR, and BTS provide evidence-based, adaptable recommendations to ensure safe and effective implementation across diverse clinical settings.