

FALL NEWSLETTER



ISCVPR

September 2026

Welcome to the Fall Edition of ISCVPR Newsletter

We're excited to look ahead to another season of learning, connection, and growth within our profession. This issue highlights exciting developments in our field and evolving evidence-based practice. With opportunities to connect and share on the horizon, there is plenty to get involved with in the months ahead. We hope you enjoy this edition and find inspiration for your own practice!

Virtual Rehabilitation

New CMS guidance has expanded the virtual rehabilitation space to include CR, ICR, and PR services delivered in the home through real-time AV technology. This article explores what this means for Indiana programs. Learn more about the potential benefits of virtual/hybrid models, as well as the key considerations programs should address before implementation.

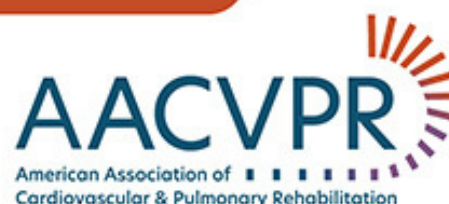


GLP-1 Medications & Exercise

A new international joint statement highlights the important role of exercise in the era of GLP-1 and other obesity medications. This article discusses why weight-loss medications should be paired with comprehensive, multidisciplinary care to help preserve muscle, strength, and mobility. It also examines the growing role of exercise professionals in supporting safe, equitable, and effective obesity treatment.

AACVPR Updates

AACVPR Board Member Debbie Koehl shares national developments shaping cardiac and pulmonary rehabilitation with key insights. This update shares details on the upcoming national conference, newly released 2027 program certification guidelines, and a new educational course for medical directors.





American Heart Association®

Heart Walk

2026 INDIANAPOLIS HEART WALK

Saturday, September 19th, 2026

REGISTER TODAY!

Celebration Plaza at White River State Park
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Gates open at 8:00am, opening ceremony is at 9:45pm, and the walk begins at 10:00am. The route has a 5k and 1 Mile option.

The Heart Walk is a fun, family-friendly event that brings our community together to get active, raise life-saving funds, and support the mission of the American Heart Association.

www2.heart.org



SAVE THE DATE



2027 ISCVPR CONFERENCE



**THURSDAY
APRIL 22ND**



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INDIANAPOLIS, IN 46204**



Register at:
<https://www.iscvpr.org/annual-meeting/>



Guest speaker
THIS COULD BE YOU!



Guest speaker
TBA





**Indiana Society
of Cardiovascular &
Pulmonary Rehabilitation**

Indiana Society of Cardiopulmonary Rehabilitation Board of Directors – Service Application

The Indiana Society of Cardiopulmonary Rehabilitation is pleased to announce upcoming elections for members of the Board of Directors. Qualification for the Board of Directors consists of:

- Current ISCVPR member for at least one consecutive year.
- Must be committed to the ISCVPR mission and vision.
- Must be willing to make a time commitment to work on behalf of ISCVPR.
- Attend Board of Directors meetings quarterly

All applications will be reviewed by the ISCVPR nominating committee. After approval from the nominating committee, elections by ISCVPR membership will take place 30 days before the annual meeting

Name: _____ Credentials _____

Email: _____

Address: _____ City: _____ State: _____ Zip: _____

Phone: _____

Current Job Responsibilities:

Years of ISCVPR Membership _____ AACVPR Member Yes No

Involvement in ISCVPR:

Why do you want to become a member of ISCVPR Board of Directors?

What skills, abilities, or attributes do you feel you can contribute to ISCVPR?

What do you view are the two greatest challenges for ISCVPR and Cardiopulmonary Rehabilitation?

What do you recommend as a solution to one of these issues?

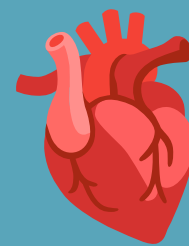
What is your vision of ISCVPR?

I hereby attest to meeting the above stated qualifications for ISCVPR Board of Directors. I verify that all information contained within this application is accurate.

Signature: _____ (esignature accepted)

Please return to: Aaron Wright at (awright11@iuhealth.org)

The Future of Cardiopulmonary Rehabilitation: Why Indiana Programs Should Reconsider Virtual and Hybrid Care Models



As cardiopulmonary rehabilitation professionals, we continue to face a persistent challenge: reaching the many eligible patients who never enroll in or complete rehabilitation. Transportation barriers, work schedules, caregiving responsibilities, rural geography, and health inequities continue to limit participation despite the well-established benefits of cardiac and pulmonary rehabilitation. Evidence increasingly supports virtual and hybrid rehabilitation models as an important strategy to expand access while maintaining quality and safety.

A Changing CMS Landscape

The virtual rehabilitation environment has evolved significantly since the COVID-19 Public Health Emergency. During the pandemic, temporary waivers allowed hospital-based programs to provide virtual cardiac rehabilitation (CR), intensive cardiac rehabilitation (ICR), and pulmonary rehabilitation (PR) services through real-time audio-visual technology. Virtual rehabilitation documents must include the regulatory framework that enabled virtual rehabilitation delivery during the Public Health Emergency.

Most recently, CMS guidance released in 2026 confirms that Medicare beneficiaries may continue to receive virtual CR, ICR, and PR services in their homes using real-time audiovisual communication technology under provisions established by the Consolidated Appropriations Act of 2026 through December 31, 2027. CMS further clarified that payment for qualifying virtual services is equivalent to in-person services and that audio-only encounters do not qualify for coverage.

In addition, CMS has permanently expanded virtual direct supervision flexibility for CR, ICR, and PR services, allowing physicians and eligible non-physician practitioners to provide supervision remotely when regulatory requirements are met.

Why Should Indiana Programs Consider Virtual or Hybrid Models?

The primary reason is access. Nationally, fewer than one in three eligible patients participate in cardiac rehabilitation, and participation remains particularly low among rural populations, older adults, women, and underserved communities. Home-based and virtual rehabilitation approaches have demonstrated outcomes comparable to center-based programs for selected low- to moderate-risk patients while helping overcome transportation and scheduling barriers. For Indiana programs serving broad geographic regions, including many rural communities, virtual and hybrid models offer several potential advantages:

- Improved enrollment and participation among geographically distant patients.
- Reduced cancellations related to weather, transportation, and work obligations.
- Enhanced continuity of care for patients returning to work after cardiac events.
- Greater flexibility for maintenance of exercise adherence and lifestyle behavior change.
- Expanded capacity without requiring significant physical space expansion.
- Opportunities to reach populations traditionally underrepresented in cardiopulmonary rehabilitation.

Key Considerations Before Implementation

While the opportunity is exciting, virtual rehabilitation is not simply "rehab over Zoom."

Programs must carefully consider:

- Appropriate patient selection and risk stratification.
- Emergency response planning for patients exercising remotely.
- Technology requirements and digital literacy support.
- Staff training and workflow redesign.
- Documentation and compliance requirements.
- Maintenance of AACVPR-quality standards and core program components.
- Collection of outcomes data to demonstrate effectiveness and support future advocacy efforts.

Importantly, virtual CR, ICR, and PR services must continue to include all required rehabilitation components, including exercise training, patient education, outcomes assessment, psychosocial assessment, and individualized treatment plan review requirements.

Looking Ahead

The current CMS flexibility creates a unique opportunity for Indiana cardiopulmonary rehabilitation programs to develop innovative care models that improve access without compromising quality. As AACVPR continues to advocate for permanent coverage, programs that implement high-quality virtual and hybrid services can contribute valuable real-world outcomes data to support the future of rehabilitation delivery.

The question may no longer be whether virtual rehabilitation has a role in cardiopulmonary care, but rather how we can thoughtfully integrate virtual options into our programs to ensure every eligible patient has an opportunity to participate and achieve better health outcomes.

References

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3. Centers for Medicare & Medicaid Services (CMS). Virtual Cardiac Rehabilitation (CR), Intensive Cardiac Rehabilitation (ICR) and Pulmonary Rehabilitation (PR) Furnished by Hospital Outpatient Departments FAQ. April 2026.
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Katrina Riggan, MS

Exercise and Physical Activity in the Era of Obesity Pharmacotherapy

A call for integrated, multidisciplinary models of care to ensure safe, equitable and effective use of GLP-1 and related weight-management medications

Issued jointly by:



The Joint Statement

The International Joint Statement, *Exercise and Physical Activity in the Era of Obesity Pharmacotherapy*, calls for integrated, multidisciplinary models of care to ensure the safe, equitable and effective use of GLP-1 and related weight-management medications. Issued jointly by exercise and sport science organisations across Australia, New Zealand, North America, the United Kingdom, Europe and South Africa, it supports these medications as a major advance in obesity care while establishing that structured exercise, delivered by clinical exercise physiologists, is an essential clinical component for preserving muscle, strength and physical function during weight loss and sustaining outcomes after treatment. It calls on governments, regulators, funders and medical, allied health and international health bodies to match the rapid expansion of obesity pharmacotherapy with equitable access to that care.

The issue

Obesity now affects more than one billion people worldwide and is among the leading drivers of chronic disease and premature death, with a global economic impact exceeding USD 2 trillion a year¹. Glucagon-like peptide-1 receptor agonists (GLP-1) and related incretin-based obesity pharmacotherapies* represent a landmark advancement in the management of obesity and metabolic disease. Clinical trials demonstrate that semaglutide achieves mean weight reductions of approximately 15% at 68 weeks² and tirzepatide up to 21% at 72 weeks³. More recently, oral GLP-1-based therapies have been approved in the United States^{4,5} with more modest weight-loss efficacy than the highest-efficacy injectable agents, highlighting that treatment response varies by agent, formulation and individual. These medications are explicitly indicated as adjuncts to physical activity and dietary modification, not stand-alone treatments⁶. Yet, despite growing recognition that obesity should be managed through comprehensive multidisciplinary care, GLP-1-based therapies are still frequently prescribed without structured exercise, dietary and behavioural support.

A critically important and under-recognised consequence of pharmacologically induced weight loss is the concurrent loss of lean body mass. Current evidence from systematic reviews and meta-analyses indicates that 20–40% of total weight lost during treatment with GLP-1-based therapies may come from lean tissue, including skeletal muscle, although the precise magnitude of muscle loss is not yet well characterised^{7,8}. With the most potent agents – semaglutide 2.4 mg and tirzepatide 15 mg weekly – a greater share of the weight lost appears to come from lean tissue than when weight is lost through lifestyle change⁷. Skeletal muscle is not simply structural tissue. It is the body's primary site of insulin-mediated glucose disposal and a major determinant of whole-body insulin sensitivity⁹. It is also a key endocrine organ, releasing myokines that help regulate metabolism and inflammation¹⁰, and it underpins physical strength, functional independence and healthy ageing¹¹. Skeletal muscle loss during substantial weight loss is therefore a clinically important consideration that warrants further investigation and strategies to minimise lean tissue loss and reduce the risk of functional decline.

For older adults and those with pre-existing low muscle reserve or chronic disease, unmanaged loss of lean mass may increase the risk or accelerate sarcopenia and frailty, leading to declines in mobility and independence^{12,13}. The World Health Organization calls for these medicines to be delivered within comprehensive chronic obesity care programmes that combine pharmacotherapy with behavioural support, physical activity and long-term follow-up¹⁴. Despite this vision, multidisciplinary obesity care remains inconsistent across many health systems. This statement is the exercise and sport science community's response to that call.

* Throughout this statement, the term "GLP-1 therapy" is used as a collective shorthand for GLP-1 receptor agonists and other approved incretin-based pharmacotherapies used in the treatment of obesity and type 2 diabetes, including dual GIP/GLP-1 receptor agonists such as tirzepatide. These agents are also described as incretin mimetics or, increasingly, nutrient-stimulated hormone (NuSH) therapies, reflecting a broadening class of single, dual and triple agonists acting on GLP-1, GIP, glucagon and related nutrient-stimulated hormone pathways. For readability and consistency with current policy and clinical usage, GLP-1 therapy is retained as the collective shorthand.



Purpose and audience

This statement sets out the shared position of the signatory exercise and sport science organisations around the globe on the role of exercise and physical activity in the safe and effective use of GLP-1 and related obesity medications. The signatory organisations support these medications as an important advance in obesity care; this statement addresses the clinical role of exercise, and of the clinical exercise physiologists who deliver it, in ensuring the benefits of these medications are realised and sustained.

This Statement is grounded in current research and clinician input and informed by consultation with researchers and prescribing clinicians. It is intended for governments, health ministries, regulators, funders, medical and allied health bodies, universities and international health institutions whose decisions shape how obesity care is delivered, subsidised and supported. Its purpose is to ensure that the rapid expansion of obesity pharmacotherapy is matched by equitable access to the multidisciplinary care, including clinical exercise physiologists, needed to protect patient safety and long-term health and function.

This statement concerns the role of clinical exercise physiology within multidisciplinary obesity care in the era of obesity pharmacotherapy. The discipline is delivered by university-qualified practitioners whose professional titles differ internationally, including Accredited Exercise Physiologists (Australia), Clinical Exercise Physiologists (United States, New Zealand and the United Kingdom), Certified Exercise Physiologists (Canada) and Biokineticists (South Africa). Unless referring to a specific profession or jurisdiction, these practitioners are collectively referred to throughout this statement as clinical exercise physiologists.

Why clinical exercise physiologists are essential for this cohort

Obesity is a complex, chronic and relapsing condition, not a simple matter of willpower or 'eating less and moving more'. Its causes are a multifactorial interplay of genetic, epigenetic, neurobiological, environmental, psychological, physiological, behavioural and sociocultural influences (see Figure 1), and obesity management should reflect that complexity. For this reason, physical activity for people on obesity pharmacotherapy cannot be reduced to generic advice to 'move more'. It should be individually assessed, prescribed and progressed by a clinical exercise physiologist who can account for each patient's comorbidities, medications and risk profile.



Figure 1. Multifactorial drivers of obesity

Structured exercise, particularly progressive resistance training, is among the most effective evidence-based interventions available for attenuating skeletal muscle loss and maintaining strength during weight loss^{11,15}. Its benefits, however, extend well beyond muscle preservation. Regular exercise also improves physical function and independence, cardiorespiratory fitness, mental health, quality of life, and metabolic and cardiometabolic health, with many of these benefits occurring independently of weight or body-composition change^{16,17}. Maintaining lean tissue, strength and physical capacity remain important clinical considerations during GLP-1 therapy, where a substantial proportion of rapid weight loss may comprise lean mass⁷. This effect is not uniform across patients and is most likely to be clinically significant in susceptible individuals, including older adults and those with low muscle reserve or chronic disease¹².

Evidence indicates that resistance training performed alongside GLP-1 therapy attenuates lean-mass loss, improves physical function and results in more favourable changes in body composition than pharmacotherapy alone¹⁵. The S-LiTE randomised controlled trial and its one-year post-treatment follow-up demonstrated better weight-loss maintenance when supervised exercise was combined with liraglutide 3.0 mg. Participants in the combined intervention were more likely to maintain a clinically meaningful ($\geq 10\%$) weight loss and regained less weight during the year after treatment cessation than those who received liraglutide alone^{18,19}. Whether similar maintenance benefits extend to the higher-efficacy agents now in widespread use – semaglutide 2.4 mg and tirzepatide – remains to be established in adequately designed trials and is an important evidence gap.

The durability of GLP-1 treatment outcomes remains uncertain in the context of high rates of treatment discontinuation. The positive effects of GLP-1 pharmacotherapy, including weight loss, improvements in metabolic health and reductions in cardiometabolic risk, are largely contingent on continued treatment. However, real-world discontinuation rates are high, with approximately half of individuals prescribed a GLP-1 receptor agonist for obesity ceasing therapy within 12 months²⁰. Both trial and real-world data show that much of the weight lost is regained within a year of treatment cessation^{21,22,23}. Sustained participation in physical activity and exercise is therefore important for maintaining lean tissue, strength, physical function and cardiometabolic health, and may improve the durability of treatment outcomes when pharmacotherapy is reduced or discontinued.

Achieving and maintaining these exercise behaviours, however, requires more than general lifestyle advice. Participants who completed a supervised exercise intervention continued to report substantially higher levels of physical activity 12 months after the program had ended, whereas no such effect was observed among those receiving pharmacotherapy alone¹⁸. These findings suggest that long-term exercise adherence is best supported through structured clinical intervention. This is particularly important because patients prescribed obesity pharmacotherapy commonly present with multiple comorbidities, including cardiovascular disease, type 2 diabetes, musculoskeletal disorders, mental health conditions and complex polypharmacy regimens²⁴. Prescribing, progressing and monitoring exercise safely in this population is both a clinical and a practical challenge. It requires practitioners who can manage clinical risk, tailor exercise to each patient's other conditions, and protect physical function, strength and long-term health during rapid weight loss.

The signatory organisations represent clinical exercise physiologists who are specifically trained to deliver evidence-based clinical exercise interventions for people living with chronic and complex conditions. These are registered allied health practitioners whose university-level clinical training equips them to assess risk and to prescribe, supervise and progress exercise in the presence of comorbidities, polypharmacy and medication-related physiological change, consistent with recognised international standards for clinical exercise physiology practice²⁵. This depth of clinical training positions clinical exercise physiologists as essential members of the multidisciplinary team delivering obesity pharmacotherapy. Their scope encompasses the following:

- Risk stratification to ensure the safety of physical assessment and individualised exercise prescription and supervision.
- Assessment of functional capacity and cardiometabolic risk in clinical populations.
- Individualised exercise testing, prescription, progression and supervision.
- Management of comorbidities, polypharmacy and medication-related factors affecting exercise participation and adaptation.
- Monitoring of muscle strength, fatigue, mobility and physical capacity throughout pharmacotherapy.
- Modification of exercise programs to accommodate musculoskeletal limitations, complex chronic disease presentations and clinical risk factors.
- Support for sustained behaviour change and long-term adherence to optimise health outcomes and weight maintenance.

Integrating these professionals into GLP-1 care pathways is not optional; it is a clinical imperative. Exercise prescription and programming delivered by clinical exercise physiologists must be recognised as a core clinical component of comprehensive obesity care, not a lifestyle add-on¹⁷. It is integral to protecting muscle mass, physical function and the durability of outcomes rather than a precondition for medication efficacy.

A call to global governments & international institutions

The undersigned organisations call on governments, health ministries, regulatory agencies, universities, medical regulatory bodies and international health institutions to act with urgency across six priority areas. Acting now, while prescribing patterns and models of care are still taking shape, can reduce the risk of avoidable functional decline, ease downstream demand and cost across health systems, and help protect community health and productivity. Delay risks locking in higher long-term costs and poorer clinical and community outcomes.



1. Embed integrated, multidisciplinary care within obesity pharmacotherapy pathways

GLP-1 and related medications should be prescribed optimally within coordinated models of care that include clinical exercise physiology, dietetics, medical oversight and psychological support. Regulatory frameworks, prescribing guidelines and reimbursement arrangements should fund and incentivise structured access to clinical exercise physiologists so that this care is genuinely available to all patients, regardless of geography or capacity to pay.



2. Address equity and access

The benefits of obesity pharmacotherapy, and the wraparound care required to use it safely, must not be limited to those who can afford private care. Obesity disproportionately burdens populations already facing systemic disadvantage, such as Indigenous and First Nations people, culturally and linguistically diverse communities, women, people in low- and middle-income countries, and those experiencing socioeconomic hardship²⁶. Consistent with the United Nations Sustainable Development Goals and international human rights frameworks, governments must ensure that access to both pharmacotherapy and integrated clinical support, including clinical exercise physiologists, is designed around equity, not ability to pay²⁷.



3. Counter weight stigma

Weight stigma is pervasive, including within health systems and among health professionals, and acts as a direct barrier to care-seeking, diagnosis and appropriate clinical management; it is associated with poorer physical and mental health and undermines the effectiveness of treatment, including obesity pharmacotherapy²⁸. Governments, regulators and health services should embed weight-stigma reduction into clinical guidelines, professional education, public messaging and the design of care environments, so that people living with obesity are met with respect and evidence-based care rather than blame. This includes recognising that physical activity messaging has itself historically contributed to weight stigma where it has been framed around personal responsibility or weight control rather than health. Clinical exercise physiologists are trained to deliver supportive, patient-centred care that is free of weight bias, and to frame movement around function, health and wellbeing rather than weight alone.



4. Align health and economic policy

The global economic impact of overweight and obesity is already around USD 2 trillion a year and is projected to exceed USD 4.3 trillion by 2035, close to 3% of global GDP²⁹. The burden falls disproportionately on low- and middle-income countries, where costs are projected to increase up to 25-fold by 2060²⁹. Investing in integrated care models, including clinical exercise physiology alongside pharmacotherapy, can help reduce functional decline, support the effectiveness of pharmacotherapy, lower long-term medication dependency and improve workforce participation. A 5% annual reduction in obesity prevalence could generate global savings of approximately USD 430 billion per year²⁹. Economic evaluations indicate that, at current prices and over standard evaluation periods, GLP-1 medications often exceed conventional cost-effectiveness thresholds for obesity without diabetes, with favourable cost-effectiveness emerging mainly in specific subgroups and over longer time periods³⁰. The value of these medications to health systems therefore depends heavily on the durability of weight loss and the prevention of rebound after treatment stops, factors that sustained exercise may help support, though this remains to be confirmed in adequately designed trials with contemporary agents²³. Funding mechanisms should support whole-of-care approaches rather than medication-only pathways.



5. Establish national and international clinical guidance and referral pathways

Governments and institutions should work with professional bodies to develop, endorse and implement clinical guidelines for multidisciplinary pharmacological obesity management, including formal referral pathways to clinical exercise physiologists. Minimising the loss of lean and muscle tissue, while supporting physical function, cardiometabolic health and overall well-being, should be recognised as core clinical objectives of obesity treatment alongside weight reduction^{16,18}.



6. Invest in research, surveillance and data sharing

Longitudinal evidence on the functional, psychological and health-economic outcomes of integrated versus medication-only care models remains limited⁹. Governments and funders should prioritise long-term research and international data collaboration, including consistent measurement of body composition that distinguishes lean mass from skeletal muscle, muscle quality and function, weight maintenance and quality of life, and research identifying which patients benefit most from different types and intensities of exercise support during obesity treatment. They should also support shared data standards and registries that track outcomes across populations. Embedding data collection within funded care pathways will allow models of care to be refined as the evidence base grows, at the pace that clinical need demands.

Shared commitments

In launching this statement, the signatory organisations commit to:



1. Informing policy with evidence. Engaging in policy consultation, contributing to clinical guideline development, and sharing evidence and international best practice to inform decisions on care-pathway design, workforce planning and funding for obesity pharmacotherapy.



2. Collaborate internationally to build a shared evidence base and professional standards.

Working across our organisations, and with researchers, clinicians and allied health bodies, to generate and translate evidence on integrated clinical exercise physiology within pharmacotherapy pathways into actionable clinical guidance.



3. Advocate for equitable access to clinical exercise physiologists as foundational obesity care globally.

Working to ensure that access to clinical exercise physiologists as part of obesity pharmacotherapy care is equitable across populations, including Indigenous and First Nations people, culturally and linguistically diverse communities, women, people in low- and middle-income countries, and those experiencing socioeconomic disadvantage. Consistent with the UN Sustainable Development Goals, advocate against weight stigma and for care models designed around equity, not ability to pay.



4. Advance recognition of exercise and physical activity as a clinical - not lifestyle - component of obesity pharmacotherapy.

Engaging health systems, policymakers and public communicators to embed this understanding in clinical practice, professional education and public policy, while recognising that effective, lasting physical activity engagement depends on individualised, person-centred and sustainable approaches delivered within that clinical framework.



5. Hold our member organisations and professions to the highest standards of practice, education and accountability.

Investing in the clinical training, professional development and quality assurance of our members to ensure they are equipped and recognised to meet the complex needs of patients on obesity pharmacotherapy. This includes continuing education that evolves with the emerging evidence on obesity pharmacotherapy and the developing therapeutic pipeline.

Debbie Koehl, MS, RRT-NPS, AE-C, FAARC, FAACVPR
AACVPR BOD member

Hope everyone had a great summer! I cannot believe it is already winding down. If you are like me you had lots of plans and did not get all of them done.

I am honored to be on the Board of Directors of the AACVPR. I wanted to give our members a little information about what is happening nationally. So, let's start!

- The 41st AACVPR Annual meeting is happening in San Antonio, TX September 30-October 2nd. It is going to be a great meeting, so I hope some of you can make it. Lots of great speakers, exhibitors and research-based poster presentations! Plus, San Antonio is so much fun!
- It's soon to be program certification time!! The newest guidelines are on the website for 2027. Even if you don't plan on certification, it is worth your while to read and follow the guidelines!
- There is now an educational offering for medical directors of cardiac and pulmonary rehabilitation programs: Leading Cardiac and Pulmonary Rehabilitation: A Medical Director's Guide to Best Practices. It is a self-paced, on-demand course. Starting in 2027 a certified program can earn a special "Medical Director Distinction" if the medical director of the program has completed this course. The cost is \$529.
- The BOD is still working with our government advocacy group in Washington DC (Hart Health Strategies) to make virtual cardiac and pulmonary rehabilitation a permanent benefit for Medicare patients!
- The AACVPR Education committee is developing some meaningful educational programs for next year! Keep an eye out for these offerings.
- The BOD wants to keep growing our membership. Many of you may have received a survey about membership and what it means to you. AACVPR wants to make sure we are an organization representing cardiac and pulmonary rehabilitation practitioners.

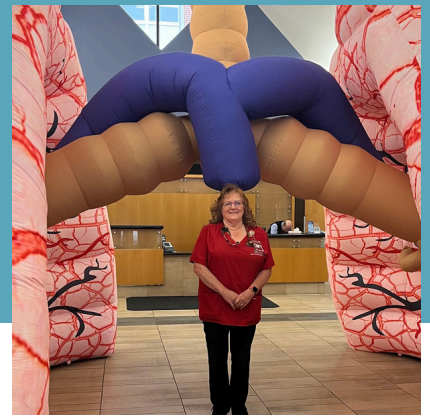
- We reviewed the AACVPR Strategic to plan to assure we are meeting those targets for both the growth and development of our mission to cardiac and pulmonary rehabilitation as a professional organization.

I am a firm believer in support of our professional societies. It is our voices that allow for change and growth in both cardiac and pulmonary rehabilitation. As a respiratory therapist, I support both of “my professions” professional organizations. I want to make sure my voice is heard as a respiratory therapist (AARC) and as a pulmonary rehabilitation professional (AACVPR and ISCVPR). So, I urge you to do the same!

Please do not hesitate to contact me at dkoehl@iuhealth.org

Cardiopulmonary Rehabilitation Competency Series

With Joni B.



Curated by:

S. Joni Bertsch MSN, RN, CCRP, Certificate in Pulmonary Rehabilitation AARC/AACVPR

IU Health Ball Memorial Cardiopulmonary Rehabilitation

This series of educational tools and articles has been thoughtfully put together to support continued growth and excellence in cardiopulmonary rehabilitation. These materials can be used to strengthen patient education efforts, enhance clinical knowledge, and promote best practices across the state.

Please feel free to explore and implement these materials to further empower your staff and elevate the care you provide.

Summer 2025

Tobacco Cessation

Fall 2025

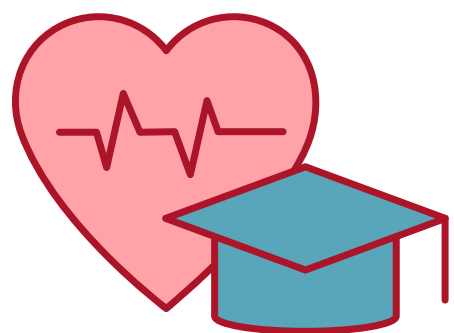
Patient Assessment

Winter 2026

Blood Lipid Management

Fall 2026

Non-COPD Respiratory Diseases



Disease-Specific Approaches in Pulmonary Rehabilitation

Charlotte C. Tenebeck, MD

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Chronic obstructive pulmonary disease (COPD) remains the most common condition for which people are referred for pulmonary rehabilitation. However, the systemic manifestations of chronic respiratory disease and the resultant dyspnea, fatigue, exercise intolerance, anxiety, depression, and functional disability are by no means unique to this disease. Since the disablement processes are often similar, there is a strong scientific rationale for administering pulmonary rehabilitation for respiratory diseases other than COPD. A listing of some of these disease states and conditions is given in figure 8.1.

Although the outcomes of pulmonary rehabilitation for non-COPD diagnoses are less studied than those for COPD, the benefits of pulmonary rehabilitation for patients with disorders other than COPD have been acknowledged in the recent ACCP/AACVPR evidence-based guidelines (1) as well as the American Thoracic Society/European

Respiratory Society statement on pulmonary rehabilitation (2). In recent years, studies of patients with a variety of disorders in pulmonary rehabilitation programs have shown that patients with non-COPD diagnoses can achieve benefits in exercise tolerance and quality of life comparable to those made by patients with COPD. These findings will be discussed in detail in the sections that follow. Based on existing data and ongoing research and the recognized benefits of pulmonary rehabilitation for patients with COPD, patients with a wide variety of respiratory disorders are increasingly being referred to pulmonary rehabilitation programs.

Despite the fact that patients with chronic respiratory diseases other than COPD stand to benefit from pulmonary rehabilitation, they also pose new challenges for the rehabilitation professional. Pulmonary rehabilitation care providers must be familiar with the physiology, clinical features, and

Figure 8.1 Conditions other than COPD for which pulmonary rehabilitation may be helpful

Obstructive lung diseases

- Asthma
- Cystic fibrosis (CF)
- Non-CF bronchiectasis

Restrictive lung diseases

- Interstitial lung disease (including survivors of adult respiratory distress syndrome)
- Restrictive chest wall disease
- Neuromuscular disease

Pulmonary vascular disease

- Pulmonary vascular disease and pulmonary hypertension

Other pulmonary rehabilitation populations

- Before and after lung volume reduction surgery
- Before and after lung transplantation
- Lung cancer and thoracic or abdominal surgery
- Coexisting respiratory and cardiac disease

unique aspects of treatment for these patients. Close partnering among pulmonary rehabilitation staff and referring health care providers remains crucial. It may be a challenge incorporating the non-COPD patient into pulmonary rehabilitation groups still largely made up of COPD patients, since disease-appropriate education and age- and disease-appropriate symptom and health-status assessment tools must be utilized. Although a substantial portion of the assessment, self-management education, exercise, psychosocial intervention, and outcome measurement are the same as for COPD, some modification will be necessary to ensure patient safety and meet individual needs. An individualized, disease-appropriate approach to pulmonary rehabilitation geared to achievement of realistic goals remains necessary for all patients. This section will review the approaches to pulmonary rehabilitation for patients with obstructive lung diseases other than COPD, restrictive lung diseases, pulmonary hypertension, and postoperative and lung cancer patients.

OBSTRUCTIVE LUNG DISEASES

As discussed, there is a vast body of research supporting the use of pulmonary rehabilitation in patients with chronic obstructive lung disease. This data is the backbone of the recommendations throughout this book, except when otherwise noted, and thus will not be further elaborated on in this chapter. In this section, we'll cover research

focused on asthma, cystic fibrosis, and non-cystic fibrosis bronchiectasis.

Asthma

Asthma is a chronic inflammatory disorder of the airways characterized by episodic bronchoconstriction, airway hyperresponsiveness, and intermittent exacerbations of airflow obstruction. As in COPD, dynamic hyperinflation during exercise may occur in those with active airflow obstruction. The airway obstruction is more reversible than that of COPD, and patients generally have more variability in symptoms. While most asthma patients experience dyspnea, cough, and wheezing, there can be marked variation in measures of disease severity, including lung function and exacerbations, namely frequency and triggers. In general, patients with asthma tend to be less physically fit than those who are unaffected (3, 4), and obesity and depression have both been independently linked with poor asthma control (5). Some patients can progress to chronic airflow limitation that may become difficult to distinguish from COPD. Fear of exercise, deconditioning, and steroid-induced myopathy commonly contribute to exercise intolerance, and some patients can progress to chronic airflow limitation that may become difficult to distinguish from COPD.

General goals of asthma management include preserving normal lung function, minimizing symptoms and exacerbations, preserving physical fitness, and preventing mortality. These goals are realized through pharmacological management, education, and promotion of physical activity.

Although all asthma patients stand to benefit from education and promotion of a healthy lifestyle, those with well-controlled asthma and without significant functional impairment generally do not need referral to a pulmonary rehabilitation program. Pulmonary rehabilitation should be reserved for those who remain dyspneic despite maximal medical therapy or have individualized educational needs. A systematic review performed in 2014 showed that structured physical activity showed a statistically significant improvement in cardiopulmonary fitness by measure of maximum oxygen uptake (6). Additionally, recent studies have shown that exercise training can improve anxiety, depression, and quality of life in moderate to severe asthmatics (7). There has been no evidence that exercise improves spirometric measurements; however, this is most likely due to the dynamic and reversible nature of asthma.

Some program modifications that may be necessary for patients with asthma are listed in figure 8.2 (8).

Many asthmatics do not use their maintenance inhalers correctly or adherently, often due to lack of education and training. Improving adherence is associated with a reduction in symptoms and improved quality of life in patients with asthma; as such, the goal of pulmonary rehabilitation in this

patient population should focus on these factors (9). Additionally, because recurrent corticosteroid use contributes to obesity and metabolic syndrome, nutrition counseling should be provided.

People with well-controlled asthma can have normal cardiopulmonary responses to exercise. Unlike other pulmonary disorders, resting lung function is a poor predictor of exercise ventilation, and therefore cardiopulmonary exercise testing is particularly helpful in determining the causes of exercise intolerance, ascertaining the risk of exercise-induced bronchospasm, and formulating the exercise prescription for individuals (10). Strategies to prevent or manage bronchospasm must be incorporated into the rehabilitation plan, such as administration of an inhaled beta-agonist, warm-up exercises, and breathing techniques (8, 11). A 2013 systematic review showed that a variety of structured exercise programs, both aerobic and weight-training, improved cardiopulmonary fitness and quality of life. In patients with well-controlled asthma, training intensity may be set near the anaerobic threshold or at a high percentage of the maximal heart rate or peak VO_2 . Low-intensity exercise, isometric exercise, or both may be suitable for severely disabled people unable to exercise at higher intensity. Endurance training of the upper and lower extremities can

Figure 8.2 Pulmonary rehabilitation program modifications for patients with asthma

Exercise assessment

- Cardiopulmonary exercise testing (CPET) when possible
- Evaluation for exercise-induced bronchoconstriction (EIB)

Exercise training

- Preexercise warm-up and postexercise cool-down
- Medication before exercise to prevent EIB
- Upper- and lower-extremity strength and endurance exercise

Age-appropriate patient and family education topics

- Recognition and avoidance of triggers
- Role of medical therapy

- Disease-modifying versus symptom-controlling medications
- Importance of medication compliance
- Peak expiratory flow monitoring
- Variable symptoms of an asthma exacerbation
- When to contact your care provider: developing an effective communicative relationship
- Self-management plan
 - Management of baseline symptoms
 - Management of exacerbations
 - Stress, anxiety, and coping techniques
 - Nutritional evaluation and counseling
- Dietary evaluation for patients requiring chronic systemic steroids

promote weight loss and possibly reverse some of the muscle weakness caused by chronic steroid use.

There are no formal recommendations for assessing outcomes in asthmatics, but studies have often measured 6-minute walk distance, spirometry, maximal oxygen uptake, and maximal heart rate (6). Symptoms can be assessed with the Juniper Asthma Quality of Life Questionnaire (12), Pediatric Asthma Quality of Life Questionnaire (13), and St. George's Respiratory Questionnaire (14). Psychosocial symptoms can be evaluated with the Beck Depression Inventory and the State-Trait Anxiety Inventory (7).

Cystic Fibrosis

Cystic fibrosis (CF) is an autosomal recessive disorder in which abnormal epithelial ion transport leads to excessively thick, viscous mucus throughout the body. Respiratory consequences include diffuse bronchiectasis, progressive airflow obstruction, hyperinflation, and recurrent respiratory infections characterized by increased sputum production, bronchoconstriction, and worsening functional limitation. Nutritional failure often results due to the exocrine pancreatic insufficiency and resultant poor absorption of fat and fat-soluble vitamins. Other manifestations include chronic sinus disease, liver and biliary disease, osteoporosis, and CF-related diabetes. Although the course of CF is variable, manifestations typically begin in infancy or early childhood, and significant pulmonary function abnormalities may be present by adolescence. Advances in medical management of CF have led to improved survival such that many patients live into adulthood. In fact, patients born today are likely to have a life expectancy well into their 30s or older (15), even without taking into account recent disease-altering small molecule therapies. With these new therapies, life expectancy is likely to be more than 50 years. Nevertheless, CF leads to major morbidity, with symptoms of cough, sputum production, dyspnea, intermittent hemoptysis, exercise intolerance, functional impairment, and impaired quality of life. As the disease progresses, hospitalizations become more frequent. More than 85% of CF mortality relates to lung involvement, although double lung transplantation may be an option for some patients.

Exercise capacity tends to be maintained until patients have moderate-to-severe disease (16). Exercise tolerance is most limited during and after exacerbations. Airflow obstruction, hyperinflation,

increased ventilatory requirements resulting from dead space and gas exchange disturbances, cardiocirculatory disturbances (including pulmonary hypertension), nutrition depletion, and skeletal muscle dysfunction contribute to the exercise impairment of patients with CF (17–19). Patients with moderate-to-severe CF have ventilatory limitations to exercise. Resting or exertional hypoxemia or both are common in later stages of the disease, and some patients may be affected by exercise-induced bronchospasm. Many CF patients also have significant dynamic hyperinflation with exercise, even in mild to moderate disease. Dynamic hyperinflation is associated with increased dyspnea and with reduced lung function and exercise tolerance (20). Inspiratory muscle strength is decreased in some individuals with moderate-to-severe disease and is related to dyspnea (21). In asthma, as in COPD, leg fatigue or discomfort limit exercise for some patients (16). The cardiovascular response to exercise is normal in mild disease, but as the disease progresses and pulmonary hypertension develops, right ventricular stroke volume may be impaired (17). Higher levels of physical activity are associated with a slower decline in lung function (22), and physical fitness has been shown to be an independent predictor of survival (23).

Therapy for CF is individualized to the needs of the patient; interventions may include the following:

- Regular exercise and increased levels of physical activity
- Maintenance of adequate nutrition
- Pancreatic enzyme and vitamin supplementation
- Regular use of airway clearance techniques
- Inhaled DNase to decrease mucus viscosity
- Antibiotic therapy, inhaled, oral, or intravenous
- Bronchodilators
- CFTR modulator therapy
- Aggressive exacerbation management strategies

The need for pulmonary rehabilitation in CF increases as the disease progresses and symptoms and functional limitations become pervasive. Most patients with CF are followed in specialized centers, and thus close collaboration between the rehabilitation staff and the CF care team is essential.

Exercise training in a number of different settings has been shown to be highly beneficial and result in increased aerobic fitness and endurance, increased strength and muscle mass, decreased exertional breathlessness, and improved quality of life (16, 24–26). Some studies, especially those including exercise training over a longer period of time (1 to 3 years), have demonstrated that exercise training is associated with better maintenance of lung function over time (16, 24, 26), although the mechanisms for the noted improvement are not clear. Enhanced sputum expectoration related to physical training (in conjunction with chest physical therapy) may account for some of this improvement (27). Physical training alone should not, however, be considered a replacement for conventional airway clearance measures (28).

Maintenance of stable pulmonary function (i.e., prevention of decline) and exercise tolerance are crucial for patients with CF to prevent long-term worsening disability. The long-term effects of pulmonary rehabilitation on functional status, quality of life, frequency of exacerbations, hospitalizations, prognosis, outcomes of lung transplantation, and survival are not yet known in the CF population.

Close partnering with health care providers and maintenance of regular long-term exercise are important educational topics in CF. Additional areas of importance to the CF patient include the following:

- Pacing and energy conservation
- Pursed-lip breathing
- Strategies to remain active in work, school, social, recreational, and sport activities
- The role of antibiotics and other medications (such as steroids and bronchodilators) in managing infection and optimizing lung function

The rationale, importance, and techniques of airway clearance should be reinforced to CF patients. There are several options for airway clearance, and the technique(s) chosen should fit the patient's needs, lifestyle, and resources. Mechanical secretion clearance devices such as the vibration vest and positive pressure breathing devices can be used to augment manual chest physical therapy. Most adult patients will be well versed in this and have likely already developed a preference for their optimal airway clearance techniques. In spite of this, many will benefit from

reinforcement of additional techniques such as huff-cough and active cycle breathing.

Exercise tolerance cannot be predicted from resting measures of pulmonary function in patients with CF (29); therefore, cardiopulmonary exercise testing may help in assessing exercise capacity. It may also help in determining the relative contributions of cardiovascular, ventilatory, and deconditioning limitations to maximal exercise and may detect exercise-induced bronchoconstriction or oxygen desaturation. This information can help in formulating a safe, effective aerobic training regimen for the patient with CF (24, 30).

The goals of exercise training in patients with CF are to maintain and optimize leg and arm function and minimize the decline in strength, endurance, or functional capacity. Additional demonstrated benefits include improved exercise tolerance, lung function, and quality of life (24–26, 30). Supervised exercise training should be undertaken for at least 20 minutes but ideally 30 to 60 minutes, 3 to 5 days per week, for 12 to 16 weeks (16, 24–26). The intensity of training must be tailored to disease severity and patient tolerance. For medically stable patients, moderate-intensity training (50% of maximal work rate, 65 to 85% of maximal heart rate, or a moderate perceived exertion level) is recommended. Those unable to exercise at this level may start at a lesser intensity or duration and increase exercise as tolerated.

The intensity of training will need to be adjusted after disease exacerbations. Symptom-limited exercise may be appropriate for patients with more severe disease. Warm-up and cool-down periods should be provided. When possible, the exercise program should be tailored to include activities that the patient enjoys because motivation is important in promoting adherence to exercise over the long term. Ventilatory muscle training may also be included (resistive or threshold, conducted 10 to 30 minutes per day for several weeks) can increase inspiratory muscle strength and endurance in patients with CF (31). The effect of ventilatory muscle training on overall endurance is inconsistent, but exercise capacity has been noted in some patients (31, 32).

Oxygen saturation should be monitored and supplemental oxygen titrated to keep the SpO_2 greater than or equal to 90%. CF patients with FEV_1 less than 50% or DLCO less than 65% predicted are most likely to desaturate with exercise (17). In addition to the safety issue, supplemental oxygen can also improve exercise capacity and decrease dyspnea for hypoxemic patients (19).

Patients and staff members must pay rigorous attention to hygiene techniques during rehabilitation to avoid cross-infection of patients with bacterial pathogens that may be antibiotic resistant. Cross-infection of antibiotic-resistant organisms as well as pathogenic organisms among patients with CF is an extremely serious consideration that may alter the course of disease (33). *Burkholderia cenocepacia* is of particular concern, as it is associated with acute, life-threatening illness and is also often considered a contraindication for transplantation (34). Options for patients with this organism may include attending the last exercise sessions of the day or exercising in a non-group setting. Close attention must be paid to hand washing, standard precautions, and hospital-based aseptic techniques. Regardless of which organisms they harbor, patients with CF should always be separated by at least 6 feet (2 meters) in a health care setting. In a non-health care or community setting, only one person with CF should attend an event at any given time (35). While not strictly a community setting, most centers have interpreted these guidelines to mean that only a single patient with CF should use an exercise facility at any one time. Consideration should also be given to isolating exercise equipment (such as dumbbells or elastic bands) of patients with resistant organisms.

Nutrition intervention is crucial to maintain growth and restore and maintain weight in patients with CF (36). Caloric and protein intake must be adjusted to meet the increased demand posed by exercise training, so that weight loss is avoided. Importantly, patients with CF have excess salt and fluid loss during exercise as a result of excessive sweating, yet they may not experience thirst and tend to underestimate their fluid needs. Therefore, close attention must be paid to maintenance of adequate fluid and salt intake. Sports drinks can be useful both to replete electrolytes and provide caloric support.

Some outcome measures typically used for COPD, such as the 6-minute walk test, shuttle walk test, and measures of dyspnea, are also appropriate for patients with CF. The choice of health-status measurement tool needs to be tailored to the age and concerns of the patient. Tools that address well-being specifically in relation to having cystic fibrosis include the Quality of Well-Being Scale (37), the Cystic Fibrosis Questionnaire (38), and the Cystic Fibrosis Quality of Life Questionnaire (39). Figure 8.3 summarizes some of the issues relevant in the pulmonary rehabilitation of the CF patient.

Non-Cystic Fibrosis Bronchiectasis

Non-cystic fibrosis bronchiectasis represents a large number of different diagnoses and thus a highly varying patient population. Causes of non-CF bronchiectasis are many and include congenital disease, common variable immune deficiency, chronic obstructive pulmonary disease, history of childhood or severe adulthood infections, chronic infection with bacteria such as atypical mycobacteria, allergic bronchopulmonary aspergillosis, sarcoidosis, and many more. Published guidelines for the treatment of bronchiectasis recommend including exercise as part of the treatment plan (40). Several trials have reported data strongly supporting the use of outpatient pulmonary rehabilitation for non-CF bronchiectasis with benefits that included significant improvement in exercise tolerance (41–43), reduction in dyspnea (42), and improvements in disease and cough-related quality of life measures (42).

Similar program modifications and special considerations for providing pulmonary rehabilitation apply to patients with non-CF bronchiectasis as apply to patients with CF, with a few exceptions. Patients with non-CF bronchiectasis are not likely to be as adversely affected by specific pathogens, such as *Burkholderia cenocepacia*, though general precautions to avoid transmission of bacteria should be maintained. This population is also more likely to be older and overweight, which may contribute to decreased exercise tolerance and deconditioning differently than in the CF population, and may require a focus on weight loss rather than weight gain or maintenance. Additional modifications may need to be made depending on the underlying cause of the bronchiectasis.

RESTRICTIVE LUNG DISEASES

A variety of different diseases can lead to restrictive pulmonary physiology. Interstitial lung diseases from many different causes can cause lung volume restriction and diffusion problems. In addition, extrapulmonary factors such as chest wall disorders and neuromuscular weakness can lead to effective restriction of the lungs, as can severe obesity. These different groups of disorders are discussed separately below.

Figure 8.3 Pulmonary rehabilitation program modifications for patients with cystic fibrosis

Exercise assessment

- Cardiopulmonary exercise testing
- Identification of any exercise-induced bronchospasm (EIB)

Exercise training

- Warm-up and cool-down periods
- Strength and endurance training: upper and lower extremity
- Sodium chloride and fluid replacement especially when exercising in heat
- Monitoring of oxygen saturation; maintaining SpO₂ greater than 90%
- Monitoring of blood sugar values in patients with CF-related diabetes

Age-appropriate patient and family education topics

- Basis of symptoms (cough, sputum production, and dyspnea)
- Medical therapy (antibiotics, bronchodilators, corticosteroids, vitamins, pancreatic enzymes, DNase, CFTR modulators based on genotype)

• Secretion clearance techniques

- Controlled cough
- Postural drainage
- Vibration vest and positive end-expiratory devices
- Bronchodilators
- Pacing and energy conservation techniques
- Pursed-lip breathing
- Strategies to remain active in school, work, and recreational activities
- Benefits of long-term maintenance of regular exercise
- Potential role for lung transplantation in long-term disease management plan

Nutrition evaluation and counseling

- Weight monitoring during training
- Age-appropriate outcome measures for exercise tolerance, dyspnea, and health status
- Management of blood glucose levels and appropriate use of insulin in patients with CF-related diabetes

Interstitial Lung Diseases

Chronic interstitial lung disease is a heterogeneous group of disorders characterized by variable degrees of inflammation, fibrosis, or both, in the interstitial or alveolar compartments of the lung parenchyma. Examples of interstitial lung disease (ILD) and exercise training and education topics are listed in figure 8.4. Symptoms common to ILD include exertional dyspnea, dry cough, exercise intolerance, and fatigue. There is great variation in symptoms and treatment responsiveness, and symptom progression often leads to profound disability. If ILD is secondary to another disease process, such as connective tissue disease, patients may have additional symptoms including arthralgias, myalgias, esophageal reflux, or joint deformity (8). In contrast to COPD, wherein the principal respiratory derangements are airflow obstruction and lung hyperinflation, ILD typically

manifests as a restrictive ventilatory defect, with low lung volumes and reduced diffusing capacity. Patients tend to have rapid, shallow breathing as a result of these alterations in respiratory mechanics, and are more likely to require oxygen as their diffusing capacity diminishes, especially during exercise. This often leads to decline in health-related quality of life related to the disease itself or due to treatment side effects (44).

The primary drivers of intolerance are based on two factors. First, impaired gas exchange leads to exertional hypoxemia, which can be very severe even in spite of normal resting oxygenation, a hallmark feature of ILD. This hypoxemia increases pulmonary vascular resistance leading to vasoconstriction and ultimately pulmonary hypertension. This contributes to the second factor, cardiac dysfunction from a combination of diminished venous return and inappropriate heart rate response. The combination of these factors causes

Figure 8.4 Forms of interstitial lung disease

- Primary—Idiopathic Interstitial Pneumonias
 - Acute interstitial pneumonia (AIP)
 - Cryptogenic organizing pneumonia (COP)
 - Desquamative interstitial pneumonia (DIP)
 - Idiopathic pulmonary fibrosis (IPF)
 - Lymphoid interstitial pneumonia (LIP)
 - Nonspecific interstitial pneumonia (NSIP)
 - Respiratory-bronchiolitis interstitial lung disease (RB-ILD)
- Secondary—Inciting Exposure
 - Acute respiratory distress syndrome (ARDS)
 - Connective tissue disease-related ILD (CTD-ILD)
 - Drug-induced pneumonitis
 - Hypersensitivity pneumonitis
- Sarcoidosis
- Other
 - Langerhans cell histiocytosis
 - Lymphangioleiomyomatosis
 - Neurofibromatosis
 - Vasculitis

impaired oxygen delivery and muscle fatigue. Fibrosis does cause decreased compliance in which the increased dead space ventilation is compensated for by increasing the respiratory rate, resulting in the characteristic rapid and shallow breathing. This was often thought to lead to exercise limitation, but testing has shown that patients with ILD have a large ventilatory reserve after peak exercise. Evaluation of exertional hypoxemia with a 6-minute walk test should be performed prior to initiating an exercise program. Patients should be monitored for dizziness or syncope from impedance of venous return in the setting of pulmonary hypertension.

Another focus of pulmonary rehabilitation should be strength training. As is true of patients

with other chronic respiratory conditions, patients with ILD commonly suffer from weight loss, reduction in muscle mass, and deconditioning (45–48). Leg fatigue is often cited as the predominant symptom leading to exercise cessation, which is likely a combination of these factors. ILD patients are at risk for steroid myopathy, which can be reversed with appropriate strength training (8).

Many forms of ILD are progressive over time, with severely disabling symptoms, and are associated with impaired quality of life (49), yet medical treatment options are often limited. In turn, many patients experience anxiety, hopelessness, depression, and embarrassment about their persistent cough. Selected people with advanced disease may be candidates for lung transplantation, yet this too is a major physical and psychological undertaking. Pulmonary rehabilitation is ideally suited to meet several of the needs of patients with ILD, and it is typically mandatory in preparation for lung transplantation (50, 51).

Figure 8.5 summarizes some of the issues relevant in the pulmonary rehabilitation of patients with interstitial lung disease.

Studies have shown that patients with ILD who complete pulmonary rehabilitation can significantly improve their 6-minute walk test distance, subjective degree of dyspnea, and quality of life. It is unclear how results compare to COPD, but studies have shown that these meaningful results do not last as long as those with COPD who complete pulmonary rehabilitation. The duration of benefit may improve with a longer course of rehabilitation, and the goal is to refer early before cardiac dysfunction manifests (8). As always, the exercise program should be tailored to meet the abilities and needs of the individual patient.

Because of the complex, multifactorial basis of exercise limitation in ILD and frequent comorbidity, cardiopulmonary exercise testing is desirable in assessing the patient referred to pulmonary rehabilitation. This assesses exercise capacity, assesses mechanisms underlying exercise limitation, detects the extent of oxygen desaturation, helps in identifying comorbidities, and facilitates formulation of the exercise prescription. The incremental shuttle walk test (ISWT) is felt to better measure gains attained in ILD patients completing pulmonary rehabilitation, rather than the 6-minute walk test, given that it is a symptom-limited maximal exercise capacity test (2, 52).

The patient's oxygen requirements should be assessed by exercise oximetry, performed at the

Figure 8.5 Pulmonary rehabilitation program modifications for patients with interstitial lung disease

Exercise assessment

- CPET when possible
- 6-minute walk or shuttle walk test

Assessment of oxygen requirements

- 6-minute walk test
- Exercise oximetry: test at highest intensity level to be performed using the patient's own portable system

Exercise training

- Strength and endurance training of the upper and lower extremities
- Strong focus on pacing and energy conservation techniques
- High FiO_2 may be required during exercise training

Age-appropriate patient and family education topics

- Nature and expected course of disease
- Physiological basis of symptoms and exercise limitation (emphasize that cough is not a contagious condition)

- Expected benefits versus potential adverse effects of medical therapy
- Rationale for and proper use of supplemental oxygen
- Pulmonary airway clearance techniques (especially for persons with bronchiectasis)
- Recognition of symptoms and signs of secondary infection
- Prevention strategies: influenza and pneumococcal vaccines
- Community resources
- Advance directives
- Coping techniques for assistance in managing anxiety and depression
- Training in options for and outcomes of mechanical ventilation

Nutrition evaluation and counseling

- Prevention of muscle or weight loss
- Use of disease-appropriate health-status outcomes measurement tools

highest intensity of activity, within both rehabilitation and the home environment. Patients must also be tested using the type of portable oxygen system they use in the home setting, since some systems (such as the pulse delivery of oxygen by electronic demand device) often do not maintain adequate oxygen saturation during exercise in this patient population. Oxygen demands may be very high, necessitating the use of high-flow supplemental oxygen or reservoir devices. These requirements may pose as barriers to continuing an exercise regimen at the completion of a rehabilitation program.

General goals of exercise training are to increase strength, endurance, and functional capacity and, in turn, to improve quality of life. Demonstrated benefits of pulmonary rehabilitation among patients with interstitial lung disease or pulmonary fibrosis include the following:

- Improved exercise endurance
- Improved quality of life
- Reduced dyspnea
- Identification of supplemental oxygen requirements, especially during exercise (53–58)

The greatest improvements in exercise endurance have been seen in patients with asbestosis and idiopathic pulmonary fibrosis, and less so in patients with connective tissue disease-associated ILD. Patients with lower baseline 6MWT distances had the greatest degree of improvement (58). Because patients with ILD have restrictive physiology and high oxygen requirements, rehabilitation may not result in reductions in dyspnea for all persons. Patients should be taught pacing and energy conservation strategies as well as paced breathing techniques. An individualized plan

should be formulated to enable each patient to continue participation in hobbies and desired activities as long as possible.

Several education topics are recommended for patients with ILD during pulmonary rehabilitation (figure 8.5). Given the magnitude of disabling symptoms and the progressive nature and poor long-term prognosis of some forms of ILD, particular emphasis must be placed on helping patients cope with dyspnea, anxiety, and depression. Pulmonary rehabilitation can also serve as an environment in which patients with ILD can learn about lung transplantation and the potential option for mechanical ventilation. Discussions can and should be held regarding advance directives and end-of-life care.

Although several measures of dyspnea, including the Borg dyspnea scale, Baseline Dyspnea Index, Transition Dyspnea Index, Medical Research Council's dyspnea scale, and visual analog scale, have all been used in patients with ILD, the best means of assessing dyspnea continue to be studied. Likewise, the health-status instruments most able to detect change in health status after pulmonary rehabilitation among patients with ILD are unknown. The SF-36, SGRQ, CRQ, Quality of Well-Being Scale, and World Health Organization QOL Scale have been used to measure health status among patients with ILD, although most were developed for COPD rather than ILD. Recent studies have shown that they may be reliable surrogate tools (59).

Neuromuscular Disease

The neuromuscular disease umbrella encompasses a large number of different diagnoses, including muscular dystrophies with a variety of disease manifestations, motor neuron disorders such as postpolio syndrome, and diseases such as amyotrophic lateral sclerosis (ALS), spinal cord injury, and other diseases with loss of motor neuron innervation. Chest wall disorders with restrictive physiology are also included here.

Many patients with restrictive chest wall disease or neuromuscular disease with respiratory impairment (with or without underlying lung disease) may benefit from pulmonary rehabilitation. The incidence, severity, and natural history of respiratory impairment in these disorders vary widely, but respiratory complications occur in the majority of people at some point in the illness. Patients with stable disease may present with chronic symptoms. In patients with progressive

Figure 8.6 Examples of conditions wherein pulmonary rehabilitation may be of benefit

- Restrictive chest wall disease (e.g., kyphoscoliosis, pneumoplasty)
- Neuromuscular disease with respiratory involvement
- Muscular dystrophy
- Parkinson's disease
- Multiple sclerosis
- Postpolio syndrome
- Myasthenia gravis
- Amyotrophic lateral sclerosis
- Neuromuscular disease (including stroke) and comorbid primary lung disease

disease, symptoms change over time. For example, in patients with muscular dystrophy, those with early diaphragmatic or bulbar involvement are especially vulnerable to developing respiratory symptoms and limitations (60). Others may not develop symptoms until their disease is advanced. Many of these patients have concomitant skeletal muscle or joint dysfunction. Examples of chest wall and neuromuscular disorders are listed in figure 8.6.

People with neuromuscular disease or chest wall disease tend to have a restrictive ventilatory defect on pulmonary function testing. Many have a rapid, shallow breathing pattern, especially during exercise. Other physiological derangements may include respiratory muscle weakness, position-related mechanical disadvantage of the respiratory muscles, chest wall distortion, and reduced chest wall compliance (especially in kyphoscoliosis). Mechanical and physiological abnormalities lead to gas exchange disturbances, often with an elevated PaCO_2 (resulting from alveolar hypoventilation) and hypoxemia (related to ventilation-perfusion mismatch or a shuntlike effect at the lung bases). Cardiopulmonary testing in patients with diverse neuromuscular disease may show reduced oxygen uptake, decreased work capacity, and reduced ventilation as well as deconditioning (61).

The previously noted mechanical and physiological respiratory abnormalities plus frequent

concomitant peripheral muscle dysfunction lead to exercise intolerance. Respiratory muscle weakness or fatigue and increased oxygen consumption resulting from peripheral muscle weakness or incoordination (62) contribute to exertional dyspnea. Impaired muscle function also results in a weak, impaired cough. Furthermore, secretion clearance may be compromised by poor lung expansion or chest wall distortion. Some patients, especially those with degenerative neuromuscular disorders such as muscular dystrophy, amyotrophic lateral sclerosis (ALS), multiple sclerosis, and Parkinson's disease, develop swallowing dysfunction and therefore are at risk for aspiration. Collectively, these disturbances increase the risk of respiratory infection. Sleep-disordered breathing, including obstructive sleep apnea and the worsening of alveolar hypoventilation during sleep, is very common among people with neuromuscular and restrictive chest wall disorders, especially in the advanced stages of disease.

A large systematic review suggested that there was evidence that strengthening exercises in combination with aerobic exercise are effective for patients with muscle disorders (63). It also found evidence indicating effectiveness of a combination of muscle strengthening and aerobic exercise in patients with diverse disorders, and evidence to support breathing exercises for patients with myasthenia gravis and myotonic muscular dystrophy. Importantly, there was no evidence of adverse effects or harm from exercise.

To date, no clear published guidelines exist regarding optimal exercise strategies for the different forms of neuromuscular disease, and further investigation is needed in this area. Consultation with the patient's neurologist or a physiatrist may be helpful in formulating a safe and appropriate exercise prescription. Aerobic conditioning may be helpful in maintaining mobility and reversing deconditioning. Ambulation and cycle exercise can be performed by patients who have responded to medical therapy or are in an early stage of disease. More frequent exercise sessions of shorter duration (interval training) may be used to avoid oversteering already limited capabilities.

Strength training is usually included, but exercises may vary from resistive training to active range of motion. Those types of strength training that can induce muscle injury should be avoided. Other interventions that may be helpful include orthotics, airway clearance, and inspiratory muscle training (63). Physical therapy or occupational therapy consultation may be necessary to identify

the potential needs for adaptive equipment or orthotics necessary to maintain independence with ADLs, work, driving, or higher-order activities such as attending school.

Close attention should be given to training the patient in energy conservation and pacing techniques. Vocational rehabilitation may be useful for selected patients. Family members should be taught the basis of the patient's functional limitations and the optimal ways to provide assistance. Pursed-lips breathing training may not be appropriate for all people with neuromuscular disease. Oxygen saturation should be monitored during exercise and supplemental oxygen titrated to achieve SaO_2 equal to or greater than 88%. If appropriate, evaluation for sleep-disordered breathing should be considered.

Patients should also be taught strategies to assist with cough and secretion clearance such as the insufflator-exsufflator device, vibration vest, or positive expiratory pressure device (64). Patients should be taught to identify early signs of respiratory infection and develop a clear process of communication with the health care provider to decide on a treatment strategy. Discussion of advance directives, mechanical ventilation, tracheostomy, home and community resources, and skilled nursing or chronic ventilator facilities helps patients evaluate their options should they no longer be able to remain at home. Pulmonary rehabilitation program modifications to be considered for patients with chest wall and neuromuscular disorders are shown in figure 8.7.

PULMONARY HYPERTENSION

Pulmonary rehabilitation facilities will be increasingly involved in the care of individuals afflicted with pulmonary artery hypertension (PAH). Issues common to other chronic lung diseases are similarly manifest in patients with PAH, such as the need to improve exercise capacity, manage activities of daily living, and address quality-of-life concerns (65). There is evidence of peripheral muscle dysfunction that is similar to the muscle wasting seen in COPD (66). These patients share many of the clinical needs familiar to others struggling with chronic lung diseases, and pulmonary rehabilitation facilities can have a significant role in the care and management of this significant and compelling illness.

Figure 8.7 Pulmonary rehabilitation program modifications for patients with chest wall and neuromuscular disorders

Exercise assessment

- Disease type and severity
- Individual patient needs and functional limitations
- Consultation with neurologist or physiatrist in formulating exercise prescription (appropriate type and intensity of exercise) if needed

Exercise training

- Nature and goals of training program individualized
- Avoidance of excess muscle fatigue
- Aerobic and strength training: ambulation, cycling, water-based exercise
- More frequent, shorter-duration exercise sessions if necessary
- Interval training possibly beneficial
- Inspiratory muscle training for selected patients

Additional considerations

- Supplemental oxygen to keep SpO₂ greater than 88%
- Potential role for noninvasive assisted ventilation during exercise

- Identification of patients who may be in need of nocturnal noninvasive assisted ventilation (CPAP or BiPAP)
- Assessment of need for assistive or orthotic equipment to maintain independence with ADLs
- Inpatient pulmonary rehabilitation for patients with severe functional limitation or intensive nursing or medical care needs

Age-appropriate patient and family education topics

- Respiratory manifestations or complications of neuromuscular or chest wall disease (tailored to the person's condition)
- Secretion clearance and cough techniques
- Recognizing signs of disease destabilization and infection
- Rationale for and benefits of noninvasive assisted ventilation
- Supplemental oxygen
- Tracheostomy and mechanical ventilation
- Advance directives
- Community resources, skilled nursing facilities, chronic ventilator facilities

Much like COPD—which includes chronic bronchitis, emphysema, and asthma—those suffering with PAH have distinct and unique diagnoses that have been lumped under an umbrella term and share PAH as a common defining reality. In fact, patients with COPD may also have elevated pulmonary artery pressure and be unaware of it; as such, they may be actively enrolled in pulmonary rehabilitation (67). It is likely that pulmonary artery pressures vary with exertion at a subclinical level and that the pulmonary vascular bed exhibits adequate capacitance for pressure variation. The various etiologies that can include PAH are diverse, and it is important for the clinician to first understand the disease process the patient presents as these diseases tend to be multisystemic and involve various other clinical realities beyond pulmonary disease. Pulmonary HTN can

arise as a consequence of processes affecting the pulmonary vascular bed directly, or it may occur in conjunction with several respiratory or systemic diseases. Idiopathic primary pulmonary HTN is a disorder wherein the pulmonary vasculature is affected in the absence of identifiable risk factors or coexisting disease. Common causes of secondary pulmonary HTN include advanced parenchymal lung disease such as COPD or interstitial lung disease, chronic thromboembolic disease, left ventricular (LV) failure, HIV infection, certain collagen vascular diseases, drugs or toxins, sleep-disordered breathing, and hepatic cirrhosis with portal hypertension.

It is important to realize that these illnesses, once treated, will have different trajectories with regard to pulmonary artery pressures—for example, chronic pulmonary embolism versus

scleroderma. The former diagnosis will likely see some decline in PAH over the many years of anti-coagulation therapy, while the latter diagnosis has an inexorable deterioration in PAH which may in fact be the cause of death for these patients. It had been said the most common cause of right-sided heart disease is left-sided heart disease, and given the prevalence of cardiac disease in our society this may well be true. It is thus fortunate that many pulmonary rehabilitation providers are cognizant of cardiac rehabilitation realities as cardiac disease is clearly the most common comorbidity in our pulmonary rehabilitation centers. PAH does have unique and important aspects of the disease state that challenge our centers, and knowledge of these physiologic issues as well as appropriate management skills is paramount to providing proper care.

Perhaps the most challenging aspect of caring for PAH patients is the reality that one does not have a mechanism to easily evaluate the level of pulmonary artery pressures at any given time. Unlike the measurement of systemic blood pressure or the measurements of oxygen saturation, the pulmonary rehabilitation specialist is confronted with a significant physiologic problem and is required to use surrogate measurements and other clinical insights to anticipate evolving pulmonary artery pressure elevation. That other providers are equally confounded about being in the dark about PAH levels at any given time gives little solace to clinicians. It is for this reason that the following bullet points be addressed and acknowledged routinely in the care of patients referred with PAH.

- Patients must be counseled and interrogated as to their compliance with their medication used for the management of PAH each and every time they present for an exercise session. There is little rationale to initiate exercise if a patient has not been compliant or has forgotten to take their medication.
- Resting oxygen levels must be evaluated and an oxygen saturation at or above 90 must be established prior to initiating exercise. Oxygen saturations below 90 are associated with increased pulmonary artery pressures so it behooves the clinician to attempt to address adequate oxygen saturations at the onset of a rehabilitation session. It is fairly common to see SpO₂ levels to drop once exercise therapy has begun, so initiating exertional therapy with oxygen levels below 90 is ill conceived.

- Adequate oxygen equipment must be available to offer increasing FiO₂ as systemic arterial desaturations will occur and must be addressed in a timely fashion. Saturations that cannot be maintained above 90 should be considered a reason to terminate the exercise session.
- A baseline pulse is important to document, and the rapid evolution of tachycardia, while routinely seen in these patients, is of concern as it speaks to increasing pulmonary vascular resistance. Patients must be encouraged not to Valsalva during exercise, and pulses that reach 130 and above should be considered a cautionary level and decreasing efforts should be considered. Any decrease in BP is a red flag and exercise must be terminated immediately.
- The use of any upper-body exercise is to be kept at a low level and should not routinely include resistance training and range of motion exercises. Stretches should be brief. Weight training of the upper extremity is relatively contraindicated. If there is a specific need for this type of therapy, clearance with the PAH specialist should be obtained.
- As the ability to stop exercise is critical to avoiding hypotension and clinical deterioration, therapists should consider one-on-one patient care in those known to have severe or moderate-to-severe PAH despite therapy. When the pulmonary artery pressure is unclear, a resting tachycardia over 100 warrants close observation during exercise therapy.
- Close communication about patient status during the rehabilitation effort must be made with those primarily caring for the patient.

There are known risk factors for prognosis and survival that the clinician should be aware of as one interacts with these patients. A large study (68) observed that clinical findings such as PAH associated with portal hypertension, modified NYHA/WHO functional class IV, men over 60 years old, and family history of PAH to be independently associated with increased mortality. PAH associated with connective tissue disease, renal insufficiency, modified NYHA/WHO functional class III, resting systolic blood pressure (BP) <110 mmHg, resting heart rate >92 beats/min, 6MWD <165 m, BNP >180 pg/mL, presence of pericardial effusion, % predicted DLCO ≤32%,

and mean right atrial pressures >20 mmHg within the year preceding enrollment were also associated with significantly increased risk of death, as were scleroderma and nonscleroderma connective tissue disease categories. On the other hand, modified NYHA/WHO functional class I, 6MWD ≥ 440 m, BNP <50 pg/mL, and % predicted DLCO $\geq 80\%$ were associated with improved survival. As many centers may see sporadic cases of PAH it is advisable to review pertinent literature, as novel therapies and changing clinical realities are quickly evolving.

Exertional dyspnea, chest pain, fatigue, palpitations, dizziness, and hemoptysis are characteristic symptoms of pulmonary HTN (69). When severe, pulmonary HTN can lead to exercise-induced syncope or sudden death. The symptom of exercise-induced dizziness or presyncope is generally an ominous sign of severe disease. Decreased exercise capacity, early-onset lactic acidosis, and increased oxygen cost of work result from a combination of cardiocirculatory and gas exchange impairments. Patients with pulmonary HTN often have ventilatory limitation (with low breathing reserve) yet have demand for increased total ventilation to maintain effective alveolar ventilation and gas exchange. Physical deconditioning from relative inactivity will compound these problems. A decreased exercise tolerance is associated with reduced survival in pulmonary hypertension (70).

In the past, pulmonary HTN was erroneously considered a contraindication to exercise testing and training because of concerns of low cardiac output, arrhythmias, pulmonary venous congestion, hypoxemia, and circulatory collapse. However, cautiously administered submaximal exercise testing and training under close supervision by experienced personnel is relatively safe (71). Furthermore, the improved exercise tolerance and increased survival of patients on supplemental oxygen and newer medical therapies (72–74), the recognition that deconditioning is a coexisting factor contributing to exercise intolerance, and the inclusion of selected pulmonary HTN patients in lung transplantation programs have supported the use of pulmonary rehabilitation.

Although exercise training in the setting of pulmonary rehabilitation has not been demonstrated to improve pulmonary artery pressure or cardiac output, it nevertheless can lead to improvement in exercise tolerance by augmenting physical conditioning. In a recently published meta-analysis of PAH and exercise training (106 patients, 53 with

exercise and 53 control), exercise training led to an increase in 6-minute walk distance as well as peak oxygen uptake (75). No serious adverse events were reported. It is notable that there was no change in the World Health Organization's functional class status as a result of the pulmonary rehabilitation intervention. Pulmonary rehabilitation is currently undertaken as a routine part of pretransplantation preparation for these patients. There is an accumulating body of evidence supporting the positive outcomes pulmonary rehabilitation provides. Early literature demonstrated benefits with individuals who began with higher levels of initial 6-minute walks (>380 meters), but subsequent studies have also demonstrated significant increases in 6-minute walks in those starting with lower level capacity (79). There is no data on the impact of pulmonary rehabilitation and survival in these patients.

Although cardiopulmonary exercise testing is useful in identifying factors contributing to exercise limitation, an incremental exercise test to maximal capacity should be avoided. A submaximal study is safer, especially in patients with exercise-induced syncope, presyncope, or arrhythmia. The 6-minute walk test is a useful alternative method to assess exercise tolerance of pulmonary HTN patients (70) and provides information on prognosis.

Oxygen saturation should be monitored and oxygen therapy titrated to maintain SpO_2 at greater than 90%. Because of the potential for hypoxemia during exercise to further increase pulmonary artery pressures and lead to arrhythmias or circulatory collapse, it is reasonable to adjust the oxygen supplementation to achieve a higher SpO_2 than would usually be considered necessary in the context of pulmonary rehabilitation for patients with other conditions.

Special safety precautions are necessary to prevent falls for anticoagulated patients with pulmonary HTN. Monitoring for any dizziness, palpitations or presyncope, systemic HTN, or hypotension is of paramount importance. To this end, high-intensity exercise, or any activities that could lead to increased intrathoracic pressure or decreased RV preload and precipitate circulatory collapse (such as weightlifting without controlled breathing or other resistive exercises that require Valsalva effort), should be rigorously avoided. In general, low-intensity aerobic exercise, such as treadmill or level surface walking, and stretching or active range of motion exercise are the mainstays of therapy (77, 78). Telemetry monitoring

Figure 8.8 Pulmonary rehabilitation program modifications for patients with pulmonary hypertension

Exercise assessment

- 6-minute walk test
- CPET
- Measurement of oxygen saturation during exercise

Exercise training

- Low-intensity aerobic exercise (treadmill or level surface walking)
- Pacing and energy conservation
- Avoidance of certain activities
 - High-intensity exercise
 - Activities that may lead to increased intrathoracic pressure such as weightlifting or resistive exercise that requires Valsalva effort
- Telemetry monitoring for patients with known arrhythmia
- Oxygen saturation monitoring
 - Supplemental oxygen to keep SpO₂ greater than 90%
 - Confirmation that patient's own portable system provides adequate SpO₂
- Close blood pressure and pulse monitoring during exercise
- Exercise cessation if patient develops chest pain, dizziness, light-headedness, or palpitations

- Possible higher-intensity exercise posttransplantation

Crucial additional considerations

- Close partnership between pulmonary rehabilitation provider and patient's physicians
- Fall avoidance for anticoagulated patients
- No disruptions in continuous IV vasodilator therapy

Age-appropriate patient and family education topics

- Anatomical and physiological basis for symptoms resulting from pulmonary HTN
- Signs of right-heart failure
- Importance and benefits of supplemental oxygen
- Risks and benefits of anticoagulation
- Vasodilator therapy
- Lung transplantation
- Mechanical ventilation
- How to exercise safely to prevent deconditioning
- Nutritional evaluation and counseling (where needed)

may be advisable during exercise for patients with arrhythmias. Patients should be monitored for exercise-induced hypertension or hypotension, and exercise should be stopped if the patient develops chest pain, palpitations, dizziness, light-headedness, or syncope. Extreme caution must be undertaken to ensure that continuous intravenous vasodilator therapy is not interrupted if a patient is still on such therapy.

Pulmonary HTN patients should be taught strategies for pacing and energy conservation, and some may benefit from assistive equipment for ADLs. Each patient must be assessed individually to understand the severity of their disease and the constellation of factors contributing to

their exercise intolerance or functional limitation. Patients should be educated regarding the benefits and risks of pharmacological therapy. Special considerations for patients with pulmonary HTN participating in pulmonary rehabilitation are given in figure 8.8. Representative pulmonary rehabilitation exercise guidelines used by one specialty transplant center are shown in figure 8.9.

LUNG CANCER

Lung cancer is the leading cause of cancer deaths among men and women in the United States and elsewhere in the developed world. Cigarette

Figure 8.9 Exercise protocol for patients with pulmonary hypertension

- Patients should stop exercising immediately if they become symptomatic.
- Oxygen saturation and vital signs should be monitored during exercise and should be kept within recommended ranges.
- Low-resistance exercise (dumbbells, cuff weights, and elastic bands) is recommended; higher-intensity resistance training is not recommended.
- Lying to sitting position is acceptable after instruction in paced breathing, avoidance of Valsalva, and body mechanics. Forward bending from the waist, with the head in a lowered position, is not recommended as this may exacerbate symptoms of light-headedness and produce a Valsalva effect.
- Patients may use the stationary bicycle using arms and legs at low resistance levels.
- Arm ergometry at low resistance levels is permitted but must have a documented clinical need.
- Patients may walk on a level surface track or treadmill.
- Patients may perform stretching exercises.

smoking is the major cause of lung cancer, and women are more susceptible than men to tobacco carcinogens (76). Asbestos and other environmental exposures, including passive smoke exposure, are other etiological factors. Lung cancer contributes substantially to a high-symptom burden, impaired quality of life, high health care costs, and a 5-year survival of only approximately 14%.

Many patients with lung cancer, including those recovering from radiation or chemotherapy, are excellent candidates for pulmonary rehabilitation, especially given that many also have COPD (80). Moreover, deconditioning, cachexia, anxiety, muscle weakness, and fatigue are common contributors to disability among patients with lung cancer, and these conditions can potentially improve after pulmonary rehabilitation (81). Exercise can improve strength, sense of well-being,

and health status and can reduce fatigue among cancer patients undergoing chemotherapy (82, 83). Pulmonary rehabilitation has been shown to be a useful adjunct for patients undergoing surgical resection of lung cancer (84, 85, 86).

PULMONARY REHABILITATION AND THE SURGICAL PATIENT

When considering major surgery for a patient with chronic lung disease, medical personnel must assess whether the patient has adequate respiratory reserve to tolerate surgery and estimate the risk of postoperative complications. Screening spirometry is needed for all patients with chronic respiratory disease before thoracic or upper abdominal surgery.

In general, any patient undergoing thoracic, upper abdominal, or abdominal aortic aneurysm surgery is at risk of developing postoperative pulmonary complications, particularly if the person has smoked within 2 months of surgery or has underlying chronic lung disease or poor general health status.

The following are common postoperative respiratory complications:

- Infection
- Atelectasis
- Worsened gas exchange
- Bronchoconstriction
- Thromboembolic disease
- Respiratory failure requiring prolonged mechanical ventilation

Comprehensive exercise testing may provide useful information in the preoperative assessment of patients whose pulmonary function results are marginal. Low exercise tolerance is associated with poor surgical outcome and reduced survival. Occasionally, pulmonary rehabilitation can lead to such an improvement in exercise capacity that a patient initially considered inoperable may become a candidate for potentially curative surgery (87, 88).

Pulmonary rehabilitation can optimize the respiratory patient's medical and functional status before major surgery, help prevent postoperative complications, and speed up the restoration of functional status. The principles of pre- and postoperative pulmonary rehabilitation (includ-

ing exercise training) for respiratory patients facing surgery are the same as for rehabilitation in general. However, some specific considerations apply to the patient preparing for or recovering from surgery.

When feasible (i.e., nonemergent surgery), patients should abstain from cigarette smoking for at least 2 months preoperatively (89); a specific smoking cessation program or counseling may be necessary in this regard. Patients should be trained preoperatively in lung expansion and airway clearance techniques, including deep breathing, incentive spirometry, posture, splinting, and assisted coughing. Patients should also be familiarized with the planned surgical procedure and chest tubes as well as trained in pacing, energy conservation, pain management, venous thrombosis prevention, bed mobility, and methods for performing transfers. Nutrition counseling and anxiety management are also important.

Exercise training duration should be based on the time frame for surgery as dictated by medical necessity. Short-duration (2 to 4 weeks) preoperative pulmonary rehabilitation for respiratory patients about to undergo major elective surgery is feasible, although its safety and benefits need confirmation in larger randomized controlled trials. Various types of exercise training programs have been used successfully for these patients (90, 91, 92).

Postoperatively, patients should be mobilized as early as possible. The implementation of pain control and lung expansion strategies learned before surgery is crucial to minimize atelectasis and assist in the clearance of secretions. Gas exchange should be monitored closely, and non-invasive positive pressure ventilation should be used, when necessary. Adequate nutrition should be assured. Stretching, range of motion, and ambulation exercises should begin as soon as is medically feasible (93).

After hospital discharge, exercise training can be continued in a standard outpatient pulmonary rehabilitation program. Uncontrolled clinical studies have demonstrated that postoperative pulmonary rehabilitation (after lung cancer resection surgery) improves walking endurance, increases peak exercise capacity, and reduces dyspnea (94, 95, 96, 97). Further studies are needed to assess the impact of postoperative pulmonary rehabilitation on perioperative complications and survival.

A summary of the program content and components that need to be emphasized or modified for patients undergoing pulmonary resection or other

Figure 8.10 Pulmonary rehabilitation program modifications for patients with lung cancer or those undergoing thoracic or upper abdominal surgery

- Exercise training to increase muscle strength and endurance
- Pulmonary rehabilitation once chemotherapy or radiation therapy is completed
- Self-management strategies
- Assessment of need for assistive equipment and services
- Psychosocial intervention: coping, stress, and anxiety management techniques
- Education
 - Breathing retraining
 - Pacing
 - Energy conservation
 - Nutrition
 - When to seek health care services

thoracic or upper abdominal surgery is shown in figure 8.10.

Lung Volume Reduction Surgery

Lung volume reduction surgery (LVRS) is a procedure wherein severely emphysematous lung tissue is resected via open sternotomy or video-assisted thoracoscopy in an effort to improve pulmonary function, respiratory mechanics, and exercise tolerance for highly selected patients with severe emphysema. Those who experience debilitating dyspnea and exercise intolerance despite optimal medical therapy and who are otherwise medically stable may be candidates. The surgical techniques, details of patient selection, and clinical outcomes have been reviewed elsewhere (97, 98, 99). Improvements in FEV₁, lung volume, gas exchange, exercise tolerance, dyspnea, quality of life, and survival have been demonstrated after LVRS (100). The noted benefits result at least in

part from improved elastic recoil, reduced hyperinflation, improved respiratory muscle function, improved cardiac function, and reduced central respiratory drive.

Pulmonary rehabilitation administered before LVRS is safe and effective (101, 102). In the National Emphysema Treatment Trial (NETT) wherein 1,218 patients underwent outpatient pulmonary rehabilitation before and after randomization to LVRS versus medical care, pulmonary rehabilitation led to significant improvements in peak exercise workload (cycle ergometry), walking endurance (6-minute walk test), dyspnea, and quality of life. Improvements in VO_2 max and muscle strength can also result from pulmonary rehabilitation before LVRS. No increased incidence of adverse events has been reported in pulmonary rehabilitation for patients with severe COPD preparing for LVRS as compared with persons with more moderate severity of disease. In addition, exercise training and pulmonary rehabilitation may potentially reduce some of the postoperative complications, and postoperative training may hasten recovery.

The principles of pulmonary rehabilitation for patients considered for LVRS are similar to those for patients with chronic lung disease. Good communication among the patient and family, the pulmonary rehabilitation staff, and the

referring pulmonary and surgical physicians is crucial for optimal results. This collaboration will include formulating patients' goals and designing the exercise training regimen, including modes, intensity, and duration. A specific exercise prescription can be formulated based on the results of comprehensive cardiopulmonary exercise testing. After LVRS, pulmonary rehabilitation is helpful in reversing deconditioning, improving mobility, and monitoring oxygenation and the need for medications.

Aspects of pulmonary rehabilitation that require special consideration for patients undergoing LVRS are shown in figure 8.11.

Lung Transplantation

Pulmonary rehabilitation also plays an essential role in the management of patients who are undergoing lung transplantation. Patients with chronic lung disease who are being considered for transplantation should undergo pulmonary rehabilitation prior to and following transplantation (103).

Before Transplantation

Pretransplant pulmonary rehabilitation is important for several reasons. Goals include optimizing then maintaining functional status before surgery.

Figure 8.11 Pulmonary rehabilitation program modifications for patients undergoing lung volume reduction surgery

- Assessment to determine the selection of surgical candidates
- Communication between pulmonary rehabilitation and surgical team
- Formulation of exercise prescription based on CPET
- Preoperative exercise training to reduce postoperative complications
- Education
 - Risks versus benefits of surgery
 - Lung expansion techniques and mobilization postoperatively
 - Pain management
- Nutrition support
- Postoperative exercise training
 - Adjusted training regimen: increased intensity and duration over time
 - Modification of immediate postoperative rehabilitation as a result of the following:
 - » Prolonged air leaks
 - » Extended tube thoracostomy
 - Concurrent medical conditions that precluded transplantation

Even though dyspnea and functional status may improve considerably, this usually does not obviate the need for transplantation, given the progressive nature of the underlying disease. Optimal disease management requires that the patient understand the disease and the benefits as well as potential adverse effects of its treatment regimen, the proper use of supplemental oxygen, how to manage symptoms, and how to recognize and manage acute disease exacerbations. Moreover, lung transplantation is a major surgical procedure with substantial risk of perioperative complications and mortality (104) and the requirement for lifelong medical therapy. Pulmonary rehabilitation allows the patient to learn about the benefits and risks of transplantation, thereby helping with the informed consent process.

Impaired exercise capacity is an important predictor of thoracic surgical outcomes and survival among patients with several forms of advanced lung disease. The increased exercise tolerance achieved after pulmonary rehabilitation may, therefore, improve survival, although this has not been convincingly proven. Pulmonary rehabilitation is an ideal setting in which to identify persons who for various reasons may prove to be suboptimal candidates for surgery. It is possible that pretransplant pulmonary rehabilitation may also decrease the risk of perioperative pulmonary complications and even decrease the duration of hospitalization after transplant. A disease-specific approach to rehabilitation should be undertaken, as emphasized throughout these guidelines.

Patients who are awaiting lung transplantation are typically those with the most severe underlying pulmonary disease. As a result, the intensity of exercise training may need to be reduced. Interval training may be beneficial. Patients should exercise close to the highest workload they can tolerate from the standpoint of dyspnea or leg fatigue. Patients with severe pulmonary hypertension will require lower-intensity exercise, must be closely monitored for hemodynamic stability, and should avoid maneuvers that can increase intrathoracic pressure. Exercise should be supervised to ensure that the prescribed workload can be safely tolerated but is intense enough to have a beneficial effect.

The patient must maintain the intensity of exercise achieved in pulmonary rehabilitation up to the time of surgery, preferably by continuing exercise in a pulmonary rehabilitation center, complemented by home-based exercise. Alternatively, patients may require repeated intermittent admissions to pulmonary rehabilitation and should

at least maintain close contact with the pulmonary rehabilitation staff. During the time the patient is waiting for a transplant, the disease can progress, requiring reassessment and modifications to the patient's exercise program, medications, and oxygen prescription. Ongoing attendance in a pulmonary rehabilitation maintenance exercise program and periodic review of the home exercise prescription allow the pulmonary rehabilitation team frequent opportunities for reassessment and may also improve compliance and minimize the severity of pretransplant medical complications (105).

Pulmonary rehabilitation is an ideal setting in which to educate the patient and family regarding the following:

- The surgical procedure
- The perioperative period: controlled coughing, incentive spirometry, pain management
- Wound care, chest tubes, drains, valves
- Potential complications of transplantation
- Benefits and side effects of immunosuppressive agents
- Lung expansion and secretion clearance techniques
- Methods of assisted ventilation
- Strategies to optimize nutrition
- Management of anxiety and depression
- Postdischarge issues and requirements for follow-up

After Transplantation

Exercise intolerance and functional disability often persist after lung transplantation despite restoration of near-normal lung function and gas exchange. Skeletal muscle dysfunction plays an important role in this exercise impairment. After transplantation, muscle weakness may be present for up to 3 years, and peak exercise capacity may be decreased to 40 to 60% of predicted for up to 2 years. Immunosuppressive medications can aggravate muscle dysfunction. Muscle function can be improved with exercise training in pulmonary rehabilitation (106, 107, 108, 72). Aerobic endurance exercise training can improve exercise capacity of patients after lung transplantation (72).

Postoperative rehabilitation can begin as early as 24 hours after surgery. The goals in this phase include optimizing airway clearance and lung expansion postextubation, decreasing the requirements for supplemental oxygen, and improving

stability in the erect posture. Patients may experience tingling or pain in their extremities while the body adjusts to the immunosuppressive medication. Rehabilitation in this early period should include range of motion, basic transfer activities (e.g., sitting to standing), breathing pattern efficiency, upper- and lower-extremity strengthening, functional mobility (e.g., ambulation), and airway clearance techniques. Directed coughing is especially important because of the impairment in the cough reflex that results from denervation of the donor lung.

Resistive exercise of the upper and lower extremities can be performed in addition to simple ambulation. Special walkers can be used to facilitate walking while chest tubes are still in place. Analgesia needs to be adjusted so exercise can be performed without worsening incisional pain. Poor posture can also result from incisional discomfort. Pain may be relieved by medications, heat or ice, massage, and transcutaneous electrical nerve stimulation. When surgery has been performed via a median sternotomy or anterolateral thoracotomy, adequate time (i.e., 4 to 6 weeks) should be allowed before the patient can engage in strenuous upper-extremity exercises such as arm cycling and high-intensity strength training.

Before discharge, it is important to check that the patient's gait is stable and lower-extremity strength is adequate to lessen fall risk. Oxygen saturation levels should be monitored during different levels of exertion so that patients and their families are aware of oxygen requirements during ADLs and exercise at home. Specific assistive medical equipment should be given where necessary.

After hospital discharge, patients may return to the program site to resume pulmonary rehabilitation. Postural awareness, maintenance of good posture, use of back protection measures, avoidance of rotation, and flexion facilitate incisional integrity and reduce the risk of spinal compression fractures due to underlying osteoporosis. A major goal of rehabilitation during this phase is to achieve increased tolerance for activities of daily living.

The 6-minute walk test can usually be performed by the patient before resuming outpatient rehabilitation. Serial repetition of walk tests at regular intervals (e.g., 3, 6, or 12 months after transplant) can be helpful in monitoring progress; a decrease in exercise tolerance may be an early indicator of infection or rejection. On the other hand, some patients may be able to exercise at progressively

higher intensity, duration, or both after uncomplicated lung transplantation because they are no longer primarily ventilatory limited. Patients may need reassurance that they can safely perform activities that are more strenuous than those performed before transplant. Pulmonary rehabilitation staff must also be aware that musculoskeletal problems may arise once the patient is exercising at a higher intensity or duration level.

Posttransplantation education should focus on the following:

- Maintenance of regular exercise
- Proper nutrition
- Recognition of symptoms and signs of infection or organ rejection
- Long-term adverse effects of immunosuppression, such as neuropathy, gait disturbances, or osteoporosis

Modifications to pulmonary rehabilitation of particular relevance to patients undergoing lung transplantation are given in figure 8.12.

Patients with Coexisting Respiratory and Cardiac Disease

The common coexistence of cardiac disease with respiratory disease can pose many challenges to the pulmonary rehabilitation team. Many patients with COPD have concomitant congestive heart failure or coronary artery disease. Special consideration must be given to the educational, psychosocial, and exercise needs of such patients to determine whether pulmonary rehabilitation, cardiac rehabilitation, or both may be appropriate. To this end, the pulmonary rehabilitation provider and pulmonary rehabilitation program medical director should work closely with the patient's referring physician to do the following:

- Identify the multifactorial basis of symptoms and functional limitations.
- Formulate a safe program of exercise training.
- Determine those aspects of a rehabilitation program that may provide the greatest benefit to the patient.

Pulmonary and cardiac rehabilitation share many features, including the combination of exercise training, education, risk factor reduction,

Figure 8.12 Pulmonary rehabilitation program modifications for patients undergoing lung transplantation

Pretransplant

- Disease-specific approach to exercise training
- Exercise intensity as tolerated by dyspnea, leg discomfort, and cardiorespiratory status
- Exercise intensity generally less than post-transplantation training
- Home-based exercise for stable patients
- Periodic review of home exercise program and maintenance of exercise
- Maintenance of SpO₂ greater than 90%
- Improved stability in erect posture
- Range of motion, basic transfer activities
- Breathing pattern efficiency
- Upper- and lower-extremity strengthening
- Functional mobility and stable gait
- Postural drainage and directed cough techniques
- Analgesia titrated to exercise
- Special walker to facilitate walking with chest tubes

Age-appropriate patient and family education topics

- Risks versus benefits of transplantation
- Potential complications
- Postoperative care
- Benefits and adverse effects of immunosuppressive medications
- Lung expansion and secretion clearance techniques
- Nutrition
- Methods of assisted ventilation
- Anxiety management, coping, and relaxation techniques
- Patient and family expectations from transplantation

Immediate posttransplant period

- Optimized airway clearance and lung expansion
- Monitoring of changing requirements for supplemental oxygen

Postdischarge

- Exercise training
- Strength and endurance training of lower and upper extremities
- Continued oxygen saturation monitoring
- Emphasis on postural awareness and breathing efficiency
- Intensity and duration of exercise increased over time
- Assessment of need for assistive devices
- Educational topics
 - Back protection
 - Symptoms and signs of infection or rejection (including decreased exercise tolerance)
 - Purpose and potential adverse effects of immunosuppressive therapy
 - Maintenance of proper nutrition
 - Importance of maintaining regular exercise
 - Importance of medication adherence

and psychosocial intervention. The goals of each include improving or maintaining functional independence, enhancing self-efficacy, and initiating behavioral changes that promote positive disease modification. As with a patient who has COPD, skeletal muscle dysfunction and impairment contribute significantly to exercise intolerance in congestive heart failure, and exercise training is beneficial in this disease (73). Improvements in outcomes across several areas have been noted,

including exercise capacity, skeletal muscle function, dyspnea, fatigue, and functional status (74). Current guidelines exist for the use of cardiac rehabilitation (109) and should be used as a guide when dealing with patients who have concomitant pulmonary and cardiac disease.

Many people have symptoms, exercise intolerance, and functional status limitation resulting from both cardiac and pulmonary disease. The choice of cardiac or pulmonary rehabilitation in

these patients often depends on the predominant factors identified as contributing to exercise limitation. Other factors affecting program choice include physician or patient preference, insurance reimbursement, and local availability. The healthy lifestyle and exercise training that are promoted in a pulmonary rehabilitation program will likely benefit a patient who has concomitant cardiac disease.

Patients with underlying cardiac disease and pulmonary disease participating in a pulmonary rehabilitation program may require telemetry monitoring. As is the case for respiratory patients, they should stop exercising if they develop chest pain; discomfort; a burning sensation, heaviness, or pressure in the chest, neck, jaw, or arms; dizziness; unusual shortness of breath; palpitations; or extreme fatigue. Such symptoms may prompt the

need for further medical testing before resuming exercise training.

SUMMARY

While most of the experience in the field of pulmonary rehabilitation is in working with patients with COPD, a growing body of literature supports the use of pulmonary rehabilitation in many other populations of patients with chronic respiratory impairment, with improvement in respiratory symptoms, functional status, mood, and tolerance of ADLs. It is important to be mindful of adjustments that need to be made based on specific diagnosis, and working closely with the patient's primary care physician or pulmonologist is critical to designing a disease-specific, effective rehabilitation program.

VISIT THE WEB RESOURCE

for links to additional resources and various tools, checklists, and forms.



PULMONARY REHAB: NON-COPD RESPIRATORY DISEASES

American Association of Cardiovascular & Pulmonary Rehabilitation.(2020). Disease-specific approaches in pulmonary rehabilitation. *Guidelines for pulmonary rehabilitation programs, fifth edition/AACVPR*. (pp. 101-122). Human Kinetics.

NAME _____

DATE _____

1. Research suggests that pulmonary rehabilitation can provide benefits to patients with non-COPD respiratory diseases. It is important to:
 - a. Treat all respiratory patients the same, COPD and Non-COPD
 - b. To provide an individualized disease appropriate approach in pulmonary rehabilitation
 - c. To provide pulmonary rehabilitation to all patients with respiratory diseases
 - d. All the above

2. **Non- COPD Obstructive lung diseases** that pulmonary rehabilitation might help include: (choose all correct answers)
 - a. Asthma
 - b. Cystic Fibrosis
 - c. Non-CF bronchiectasis
 - d. Interstitial Lung disease

3. There are several type of conditions that may benefit from pulmonary rehabilitation.
Match the type of condition with the specific disease:
 - A. Restrictive Lung Disease
 - B. Pulmonary Vascular Disease
 - C. Other Pulmonary Populations
 - D. Obstructive Lung Disease

_____	Asthma
_____	Pulmonary Hypertension
_____	Lung Volume Reduction Surgery
_____	Interstitial Lung Disease
_____	Neuromuscular Disease
_____	Lung Transplantation
_____	Lung Cancer
_____	Restrictive Chest Wall Disease
_____	Coexisting Respiratory and Cardiac Disease
_____	Cystic Fibrosis

4. Otto is 52 years old and diagnosed with moderately severe asthma and is experiencing exacerbations every 1-2 months. He is unsure why. He is mostly sedentary with a full-time desk job that allows him to work remotely from home. After a recent hospitalization his physician ordered pulmonary rehabilitation. Otto does not understand why this is important and does not plan to attend. Choose the correct answer.
1. Outpatient pulmonary rehab would be indicated and beneficial because:
 - a. A recent hospitalization and frequent exacerbations indicate his asthma is not well-controlled
 - b. All asthma patients should be referred for pulmonary rehab
 - c. Pulmonary Rehabilitation can provide individualized educational needs
 - d. Pulmonary Rehabilitation can promote physical activity and help preserve physical fitness
 - e. All the above
 - f. a,c,d
 2. A pulmonary rehabilitation program modification for a patient with asthma would include:
 - a. Evaluation for exercise-induced bronchoconstriction
 - b. Taking medication before exercise to prevent exercise-induced bronchoconstriction as prescribed
 - c. Both a and b
 3. Although Otto has a normal BMI, a dietary evaluation and nutritional counseling should be provided because:
 - a. He is requiring chronic systemic steroids which can contribute to obesity and metabolic syndrome
 - b. Patients with asthma often become cachectic
 - c. Both a and b
5. Garrison is a 21 year old who was diagnosed with Cystic Fibrosis fifteen years ago. His Pulmonologist has referred him for Pulmonary Rehabilitation. Cystic Fibrosis is:
- a. A chronic inflammatory disorder of the airways characterized by episodic bronchoconstriction, airway hyper-responsiveness, and intermittent exacerbations of airflow obstruction.
 - b. An autosomal recessive disorder in which abnormal epithelial ion transport leads to excessively thick, viscous mucus throughout the body.
 - c. A heterogeneous group of disorders characterized by variable degrees of inflammation, fibrosis, or both, in the interstitial or alveolar compartments of the lung parenchyma.
6. For patients with Cystic Fibrosis it is important to reinforce the rationale, importance, and techniques of airway clearance. Technique options include all of the below except:
- a. Controlled cough
 - b. Postural drainage
 - c. Vibration vest
 - d. Positive end-expiratory devices
 - e. Bronchodilators
 - f. Manual chest physical therapy
 - g. Intake of sports drinks

7. Pulmonary Rehabilitation for patients with Interstitial Lung Disease can provide the following benefits Except:
- Meaningful results that last longer than patients with COPD
 - Improved exercise endurance
 - Improved quality of life
 - Reduced dyspnea
 - Identification of supplemental oxygen requirements, especially during exercise
8. Margo is a 63 year old who was recently hospitalized with COPD exacerbation and also has Pulmonary Hypertension. One of the most challenging aspect of caring for a patient with pulmonary hypertension is that there is not an easy mechanism to evaluate their level of pulmonary artery pressure. It is important that staff has the management skills that can provide proper care for the patient with PAH (Pulmonary Artery Hypertension). At each exercise session staff must confirm with the patient that they have taken their medication for the management of their PAH. The patient that forgot their medication should:
- Be counseled on the importance of taking their medication before exertion and then be allowed to exercise
 - Be counseled on the importance of taking their medication before exertion, that their medication is needed to safely exercise so they will need to defer exercise on that day
 - Be allowed to exercise, while watching closely for symptoms
9. During exercise training patients with Pulmonary Hypertension should **avoid** all the activities listed below with **the exception of**:
- High intensity exercise
 - Confirming that the patient's own portable O2 system is providing adequate O2
 - Weight lifting that could lead to increased thoracic pressure
 - Resistive exercises that require valsalva effort
10. After lung transplantation "exercise intolerance and functional disability often persist." "Muscle weakness may be present for up to _____.
- 6 months
 - 1 year
 - 2 years
 - 3 years

PULMONARY REHAB: NON-COPD RESPIRATORY DISEASES

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NAME _____

DATE _____

1. Research suggests that pulmonary rehabilitation can provide benefits to patients with non-COPD respiratory diseases. It is important to:
 - a. Treat all respiratory patients the same, COPD and Non-COPD
 - b. To provide an individualized disease appropriate approach in pulmonary rehabilitation
 - c. To provide pulmonary rehabilitation to all patients with respiratory diseases
 - d. All the above
2. **Non- COPD Obstructive lung diseases** that pulmonary rehabilitation might help include: (choose all correct answers)
 - a. Asthma
 - b. Cystic Fibrosis
 - c. Non-CF bronchiectasis
 - d. Interstitial Lung disease
3. There are several type of conditions that may benefit from pulmonary rehabilitation.
Match the type of condition with the specific disease:

A. Restrictive Lung Disease	
B. Pulmonary Vascular Disease	
C. Other Pulmonary Populations	
B	Pulmonary Hypertension
C	Lung Volume Reduction Surgery
A	Interstitial Lung Disease
A	Neuromuscular Disease
C	Lung Transplantation
C	Lung Cancer
A	Restrictive Chest Wall Disease
C	Coexisting Respiratory and Cardiac Disease
4. Otto is 52 years old and diagnosed with moderately severe asthma and is experiencing exacerbations every 1-2 months. He is unsure why. He is mostly sedentary with a full-time desk job that allows him to work remotely from home. After a recent hospitalization his physician ordered pulmonary rehabilitation. Otto does not understand why this is important and does not plan to attend. Choose the correct answer.
 1. Outpatient pulmonary rehab would be indicated and beneficial because:
 - a. A recent hospitalization and frequent exacerbations indicate his asthma is not well-controlled
 - b. All asthma patients should be referred for pulmonary rehab
 - c. Pulmonary Rehabilitation can provide individualized educational needs
 - d. Pulmonary Rehabilitation can promote physical activity and help preserve physical fitness
 - e. All the above

f. a,c,d

2. A pulmonary rehabilitation program modification for a patient with asthma would include:
 - a. Evaluation for exercise-induced bronchoconstriction
 - b. Taking medication before exercise to prevent exercise-induced bronchoconstriction as prescribed
 - c. Both a and b
3. Although Otto has a normal BMI, a dietary evaluation and nutritional counseling should be provided because:
 - a. He is requiring chronic systemic steroids which can contribute to obesity and metabolic syndrome
 - b. Patients with asthma often become cachectic
 - c. Both a and b
5. Garrison is a 21 year old who was diagnosed with Cystic Fibrosis fifteen years ago. His Pulmonologist has referred him for Pulmonary Rehabilitation. Cystic Fibrosis is:
 - a. A chronic inflammatory disorder of the airways characterized by episodic bronchoconstriction, airway hyper-responsiveness, and intermittent exacerbations of airflow obstruction.
 - b. An autosomal recessive disorder in which abnormal epithelial ion transport leads to excessively thick, viscous mucus throughout the body.
 - c. A heterogeneous group of disorders characterized by variable degrees of inflammation, fibrosis, or both, in the interstitial or alveolar compartments of the lung parenchyma.
6. For patients with Cystic Fibrosis it is important to reinforce the rationale, importance, and techniques of airway clearance. Technique options include all of the below except:
 - a. Controlled cough
 - b. Postural drainage
 - c. Vibration vest
 - d. Positive end-expiratory devices
 - e. Bronchodilators
 - f. Manual chest physical therapy
 - g. Intake of sports drinks
7. Pulmonary Rehabilitation for patients with Interstitial Lung Disease can provide the following benefits Except:
 - a. Meaningful results that last longer than patients with COPD
 - b. Improved exercise endurance
 - c. Improved quality of life
 - d. Reduced dyspnea
 - e. Identification of supplemental oxygen requirements, especially during exercise

8. Margo is a 63 year old who was recently hospitalized with COPD exacerbation and also has Pulmonary Hypertension. One of the most challenging aspect of caring for a patient with pulmonary hypertension is that there is not an easy mechanism to evaluate their level of pulmonary artery pressure. It is important that staff has the management skills that can provide proper care for the patient with PAH (Pulmonary Artery Hypertension). At each exercise session staff must confirm with the patient that they have taken their medication for the management of their PAH. The patient that forgot their medication should:
- a. Be counseled on the importance of taking their medication before exertion and then be allowed to exercise
 - b. Be counseled on the importance of taking their medication before exertion, that their medication is needed to safely exercise so they will need to defer exercise on that day
 - c. Be allowed to exercise, while watching closely for symptoms
9. During exercise training patients with Pulmonary Hypertension should **avoid** all the activities listed below with **the exception of**:
- a. High intensity exercise
 - b. **Confirming that the patient's own portable O2 system is providing adequate O2**
 - c. Weight lifting that could lead to increased thoracic pressure
 - d. Resistive exercises that require valsalva effort
10. After lung transplantation "exercise intolerance and functional disability often persist." "Muscle weakness may be present for up to _____.
- a. 6 months
 - b. 1 year
 - c. 2 years
 - d. **3 years**

Shape Approved Mexican Pizza Casserole



Ingredients

- 2 bags frozen, riced cauliflower
- 1 large egg
- ½ c. whipped cottage cheese
- 1 tsp. italian seasoning
- ¼ tsp. black pepper
- 1 jar shape approved salsa
- 1 lb ground beef
- 1 onion chopped
- 1 bell pepper chopped
- 3 tbs. flavor god taco tuesday seasoning
- Manchego cheese

Directions

1. Microwave riced cauliflower for 3 minutes times 2. Place in cheese cloth and squeeze out the water.
2. Place in a bowl with egg, cottage cheese and seasonings.
3. Spray 9x13 casserole dish. Place the mixture into the dish and press down. Place the crust in a 375 degrees preheated oven for 10 minutes.
4. While the crust is baking, brown the hamburger with the onion and pepper, add in the taco seasoning. Spread out a jar of salsa over the crust. Then add the hamburger mixture then top with Manchego cheese.
5. Bake for 10 minutes until the cheese is melted.

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