

Pulmonary Rehabilitation

Jimmy Johannes, MD

Medical Director, Pulmonary Rehabilitation

Pulmonary and Critical Care Medicine

MemorialCare Long Beach Medical Center

28 Jul 2023

Pulmonary Rehabilitation

"comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors"

Holland AE et al. Ann Am Thorac Soc 2021

Pulmonary Rehabilitation

Components:

- Patient assessment
- Supervised, individualized exercise training
- Individualized patient education
 - Disease
 - Symptom management
 - Medications, including inhaler and/or oxygen use if applicable
 - Airway clearance
 - Action plan
- Psychological support
- Coordination with the treating physician

Practical Considerations

Location:

- healthcare facility (hospital-based or outpatient)
- home

Frequency and Duration:

- 2-3 visits per week
- 1 hour per visit (up to 2 h if there is an intensive education component for a visit)
- 8-12 weeks duration

Monitoring:

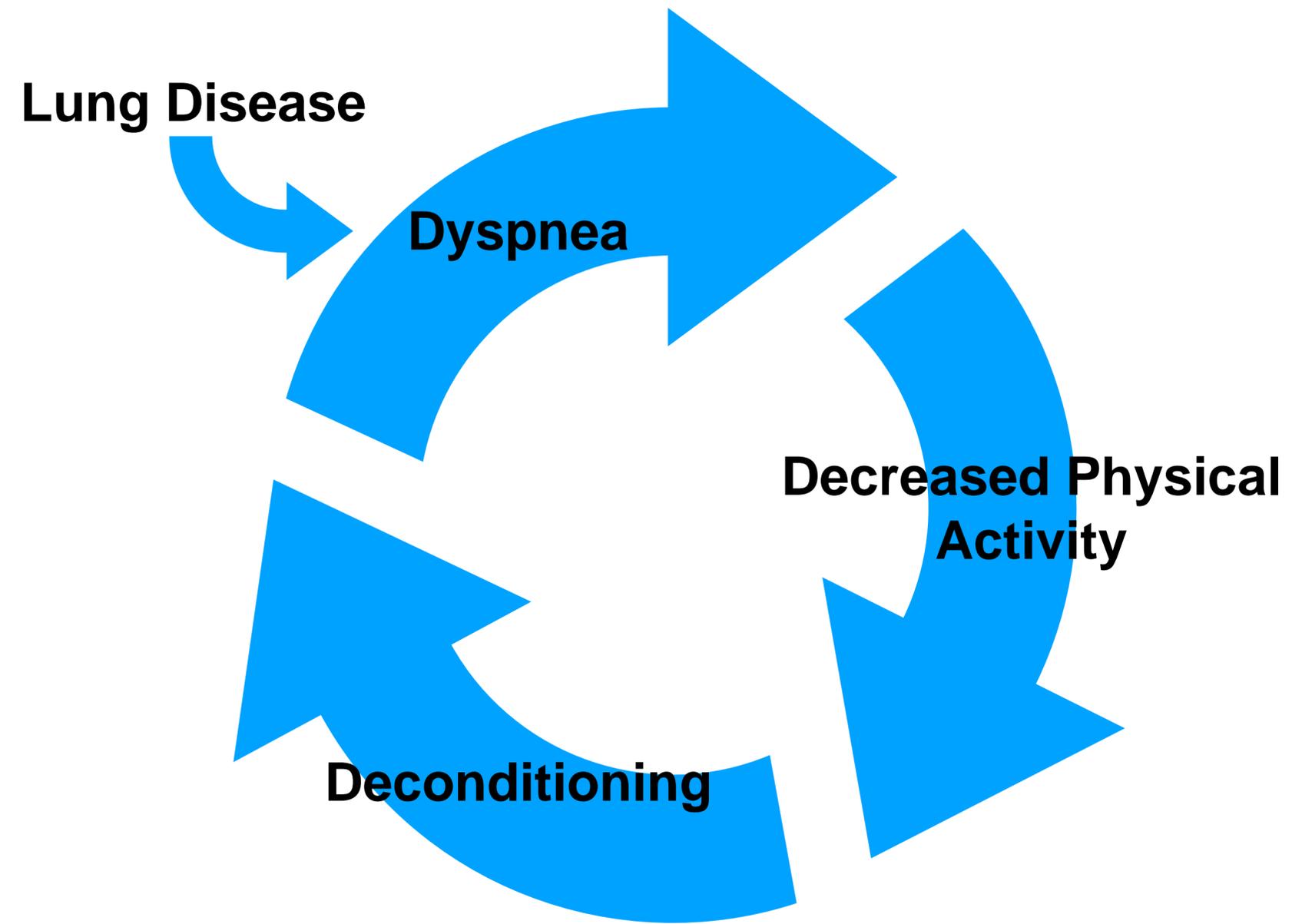
- cardiopulmonary symptoms, chest exam, BP, HR, SpO₂
- continuous pulse ox for some patients for some activities
- musculoskeletal issues (balance, gait, posture, pain)

Why is PR so important?

When lung function is limited, improved muscle function and cardiovascular conditioning are key to improving functional limitation and exertional shortness of breath

Muscle weakness/deconditioning is one of the most important drivers of exercise limitation in COPD patients

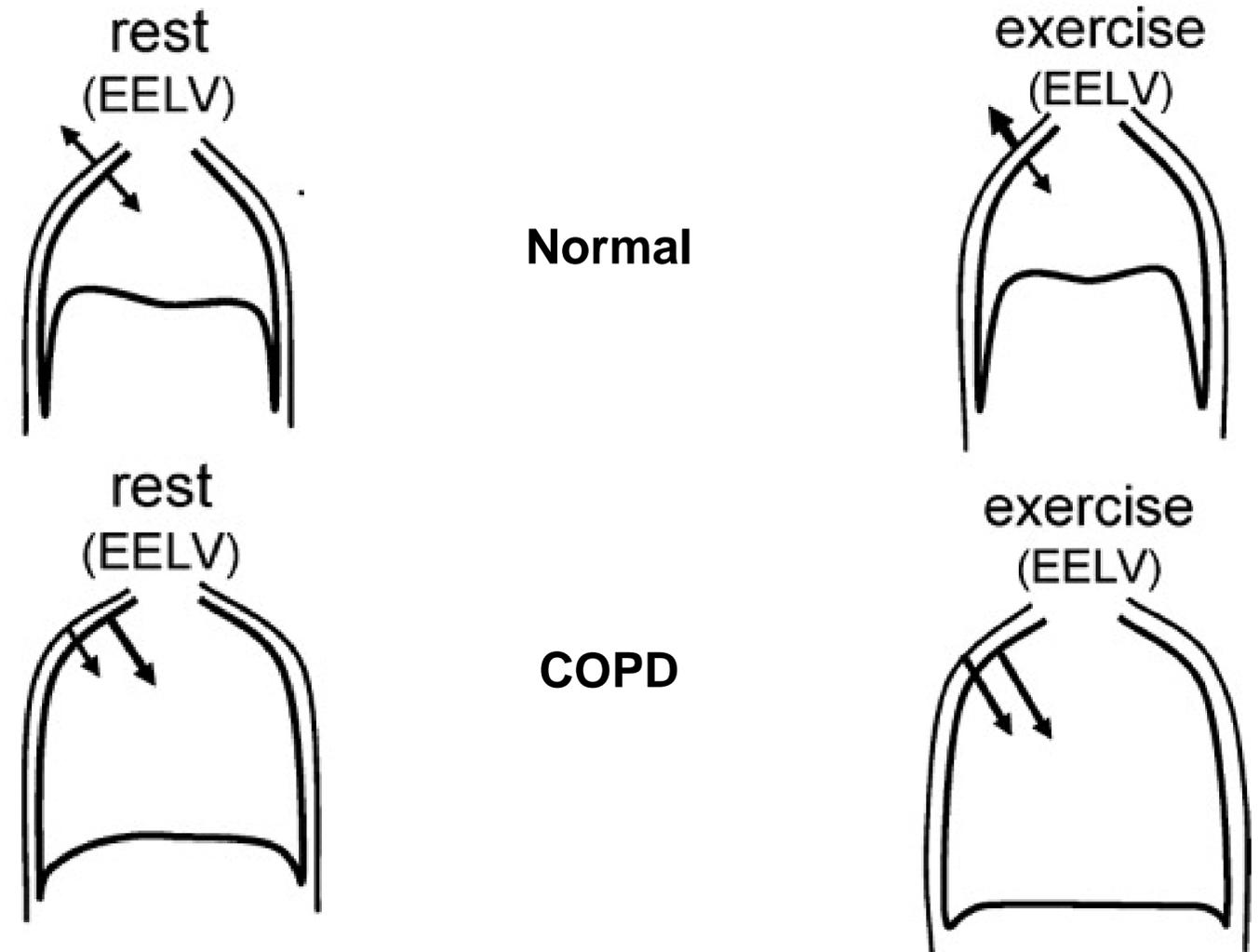
Physical inactivity is an important predictor of mortality and hospitalization in COPD patients



Benefits of PR in COPD

Dynamic Hyperinflation:

- Increased physical activity
 - ➔ Increased RR and V_t
 - ➔ Inadequate exhalation time
 - ➔ Air trapping
 - ➔ Hyperinflation



Benefits of PR in COPD

Dynamic Hyperinflation:

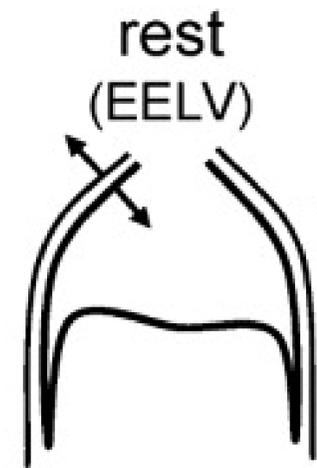
- After completing exercise program, for a given level of physical activity...

→ Vt and RR are better maintained

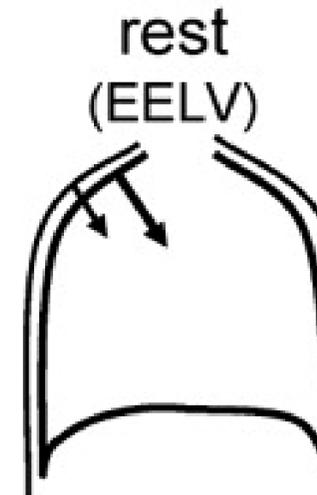
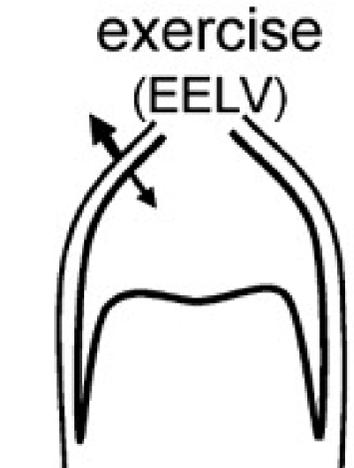
→ Exhalation time does not decrease as much

→ Less air trapping

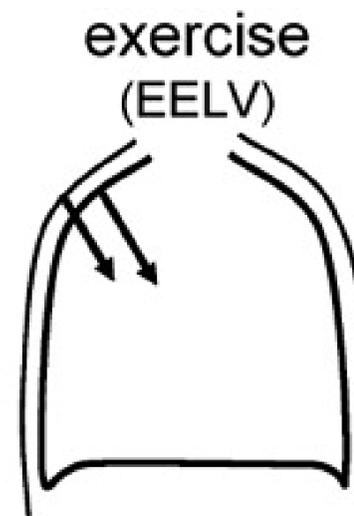
→ Less hyperinflation



Normal

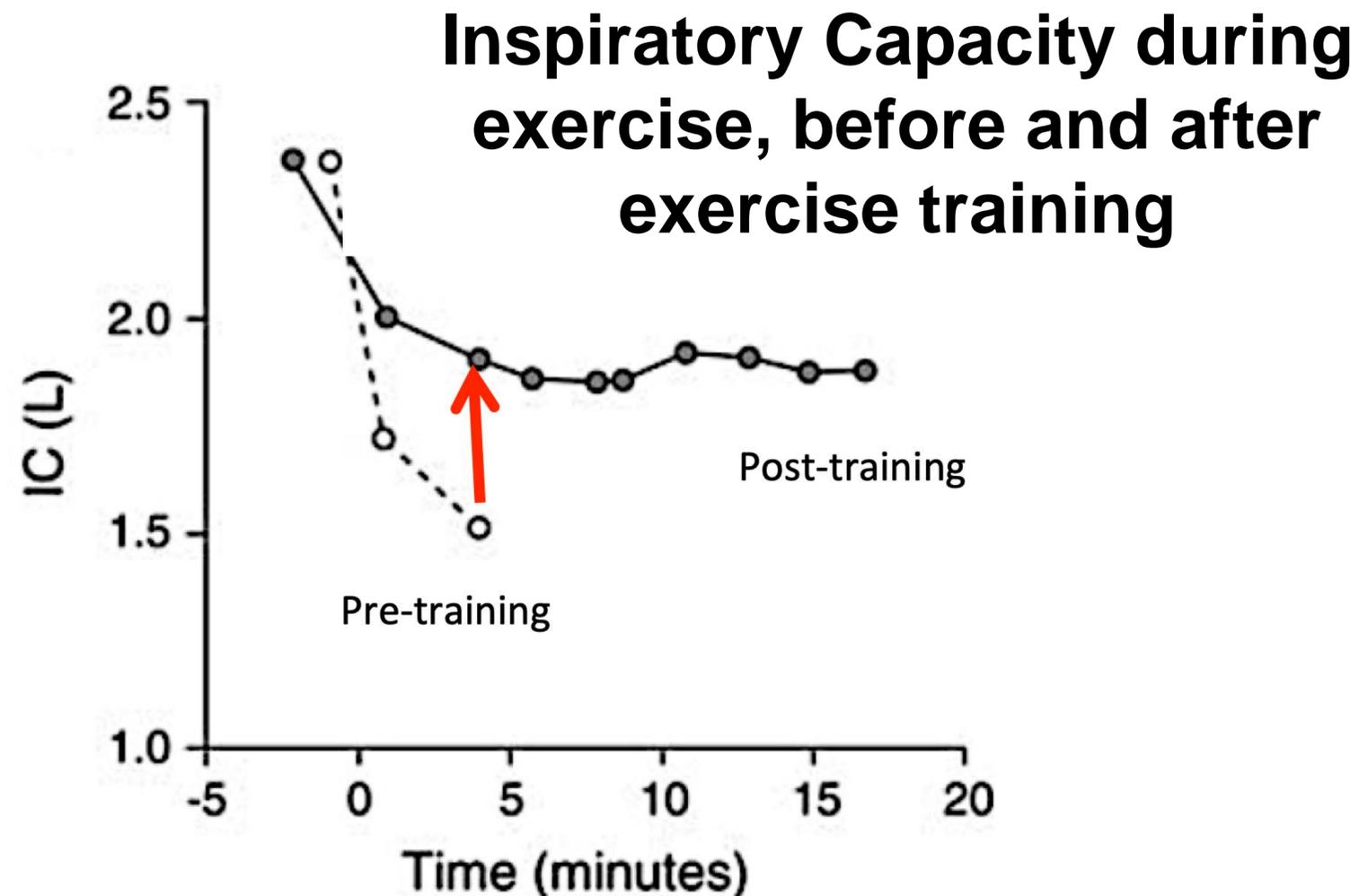


COPD



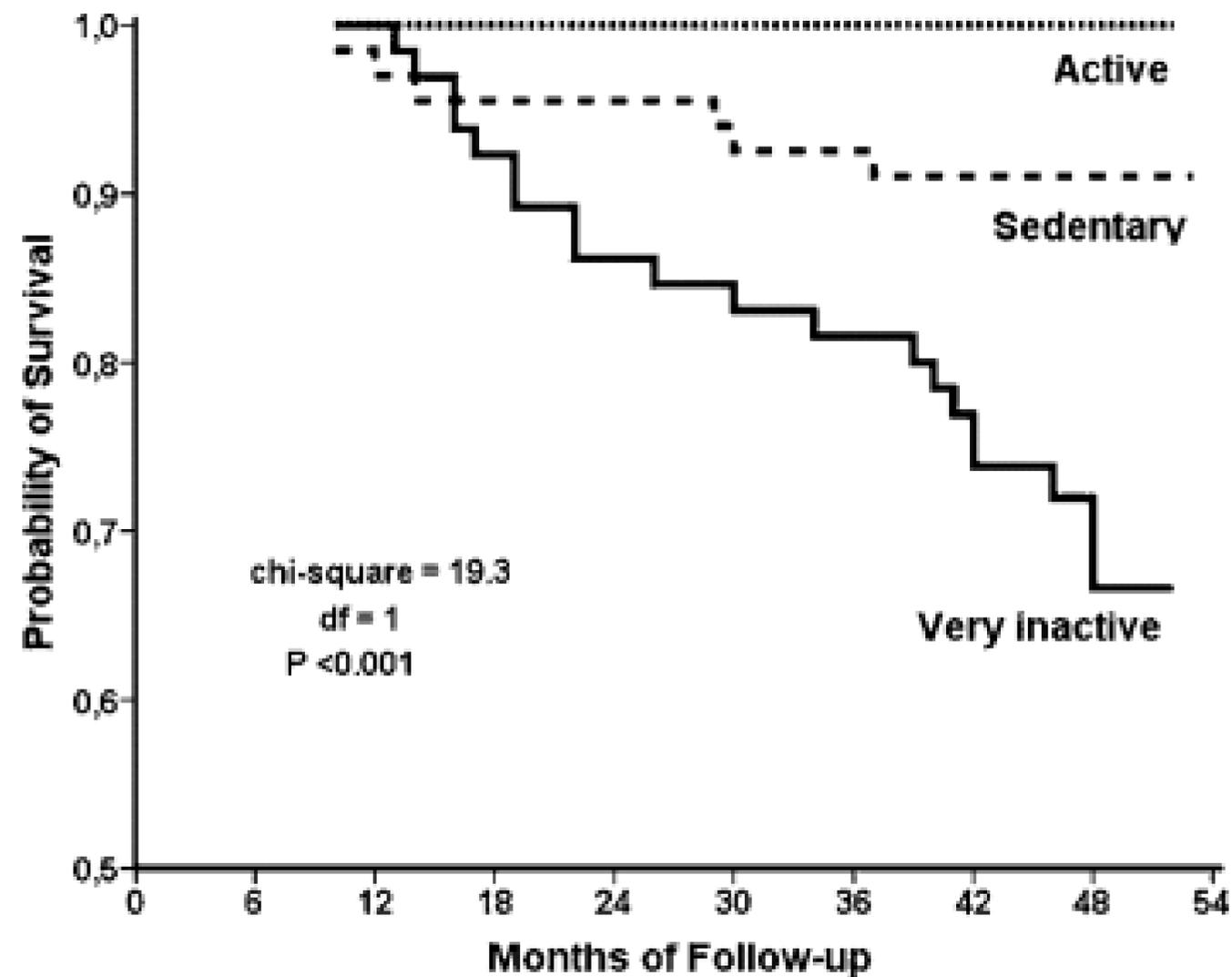
Benefits of PR in COPD

Dynamic Hyperinflation - Training can result in less hyperinflation and air trapping for a given physical activity.



Benefits of PR in COPD

Physical Inactivity is an important predictor of all-cause mortality in COPD.



Benefits of PR for COPD

Mortality - PR within 90 days of discharge from COPD exacerbation is associated with a reduction in mortality at 1 year (-6.7% [CI -7.9% to -5.6%]). Lindenauer et al. JAMA 2020

Exercise Capacity - Randomized controlled study of PR vs. conventional community care for 8 weeks then in a maintenance program for 16 weeks led to improvement in exercise tolerance and dyspnea. Goldstein et al. Lancet 1994

Frailty - Frailty is common among COPD patient referred for PR. PR is associated with reduction in frailty. In one study 60% of frail patients in PR no longer met criteria for frailty at end of PR. Maddocks M et al. Thorax 2016

Quality of Life - PR is associated with improved quality of life scores related to dyspnea, fatigue, emotional well being. McCarthy B et al. Cochrane Database Syst Rev 2015

Hospitalization - PR is associated with decreased hospitalization rates and length of stay

Benefits of PR for Other Lung Conditions

PR has been shown to improve exercise capacity and quality of life for patients with...

Interstitial Lung Disease

Bronchiectasis

Asthma

Pulmonary Arterial Hypertension

Post-Lung Transplant

Durability of Effect

Exercise capacity and quality of life scores diminish in the 12 months after program completion. McCarthy B et al 2015

Challenges

Shortage of PR programs and slots

Limited completion rate

- Distance to program
- Difficulty with transportation
- Lack of time
- Hospitalizations/illness

Frail patients, who benefit most from PR, tend to have a higher rate of not completing the program.

Exercise Regimen in PR Programs

Endurance Training - cornerstone of PR programs. 20-30 min of 60% of max work rate

Interval Training - can allow higher intensity exercise for shorter intervals for those who cannot achieve prolonged sustained exercise due to dyspnea.

Strength Training - can improve muscle mass and augment balance and endurance

Disease Management

Disease Education

Breathing Techniques

Medication Education

Inhaler Use

Action Plan for Exacerbations

Need for DME (nebulizers, walkers, OPEP, vest therapy)

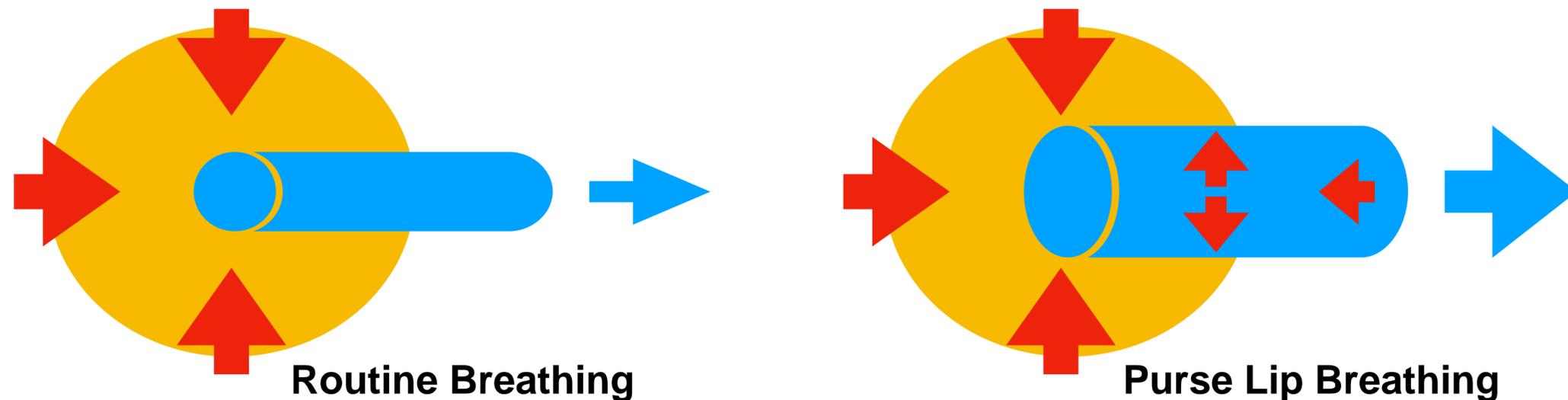
Airway Clearance Regimen

Exercises for activity maintenance

Breathing Techniques

Decreasing breathing frequency and purse lip breathing

- Increases time for exhalation
- Increases PEEP and increases airway diameter during exhalation —> improves exhalation flow rates
- Particularly helpful for obstructive lung diseases to help reduce air trapping and hyperinflation.
- Can help improve SpO₂
- Can help improve exercise tolerance



Breathing Techniques

Diaphragmatic Breathing - Using more diaphragm and less accessory muscles

- Accessory muscle use requires more effort and may enhance a sense of dyspnea and increase work of breathing
- Focusing more on diaphragm use for breathing may increase breathing efficiency and reduce the sense of dyspnea

Medication Education

SABA - Albuterol, Levalbuterol

SAMA - Ipratropium

SABA/SAMA - Albuterol/Ipratropium (Combivent)

LABA - Salmeterol, Vilanterol, Arformoterol, Formoterol, Oladaterol

LAMA - Glycopyrrolate, Umeclidinium (Incruse), Tiotropium (Spiriva), Acclidinium (Tudorza)

LABA/LAMA - Vilanterol/Umeclidinium (Anoro), Oladaterol/Tiotropium (Stiolto), Glycopyrrolate/Formoterol (Bevespi)

ICS - Ciclesonide (Alvesco), Fluticasone (ArmonAir, Arnuity, Flovent), Mometasone (Asmanex), Budesonide (Pulmicort), Beclomethasone (Qvar)

ICS/LABA - Fluticasone/Salmeterol (Advair, Airduo, Wixela), Budesonide/Formoterol (Symbicort), Mometasone/Formoterol (Dulera), Fluticasone/Vilanterol (Breo)

ICS/LABA/LAMA - Fluticasone/Vilanterol/Umeclidinium (Trelegy), Budesonide/Formoterol/Glycopyrrolate (Breztri)

SHORT-ACTING BETA₂-AGONIST BRONCHODILATORS

relax tight muscles in airways and offer quick relief of symptoms such as coughing, wheezing and shortness of breath for 3-6 hours

ProAir[®] Digihaler[™] 90 mcg albuterol sulfate inhalation powder 1238 A	ProAir[®] HFA 90 mcg albuterol sulfate 1238 A G	ProAir[®] RespiClick[™] 90 mcg albuterol sulfate inhalation powder 1238 A	Proventil[®] HFA 90 mcg albuterol sulfate 1238 A G	Ventolin[®] HFA 90 mcg albuterol sulfate 1238 A G	Xopenex[®] HFA[®] 45 mcg levalbuterol tartrate 1238 A G
---	---	--	--	---	--

LONG-ACTING BETA₂-AGONIST BRONCHODILATORS

relax tight muscles in airways and offer lasting relief of symptoms such as coughing, wheezing and shortness of breath for at least 12 hours

Serevent[®] Diskus[™] 50 mcg salmeterol xinafoate inhalation powder 1238 A C	Striverdi[®] Respimat[™] 2.5 mcg olodaterol hydrochloride 1238 C
---	---

INHALED CORTICOSTEROIDS

reduce and prevent swelling of airway tissue; they do not relieve sudden symptoms of coughing, wheezing or shortness of breath

Alvesco[®] HFA 90, 180 mcg ciclesonide 1238 A	ArmonAir[®] Digihaler[™] 55, 113, 232 mcg fluticasone propionate inhalation powder 1238 A	Arnuity[®] Ellipta[™] 50, 100, 200 mcg fluticasone furoate inhalation powder 1238 A	Asmanex[®] HFA 50, 100, 200 mcg mometasone furoate 1238 A	Asmanex[®] Twisthaler[™] 110, 220 mcg mometasone furoate inhalation powder 1238 A	Flovent[®] Diskus[™] 50, 100, 250 mcg fluticasone propionate inhalation powder 1238 A	Flovent[®] HFA 44, 110, 220 mcg fluticasone propionate 1238 A	Pulmicort Flexhaler[®] 90, 180 mcg budesonide inhalation powder 1238 A	QVAR[®] Redihaler[™] 40, 80 mcg beclomethasone dipropionate 1238 A
---	--	--	---	--	--	---	--	---

MUSCARINIC ANTAGONISTS (ANTICHOLINERGIC)

relieve cough, sputum production, wheeze and chest tightness associated with chronic lung diseases

Atrovent[®] HFA 17 mcg ipratropium bromide 1238 C	Incruse[®] Ellipta[™] 82.5 mcg umeclidinium inhalation powder 1238 C	Spiriva[®] HandiHaler[™] 18 mcg tiotropium bromide inhalation powder C	Spiriva[®] Respimat[™] 5.4, 10.8, 21.6 mcg tiotropium bromide 1238 A C	Tudorza[®] Pressair[™] 400 mcg aclidinium bromide inhalation powder 1238 C
---	---	---	---	---

COMBINATION MEDICATIONS

contain both short-acting beta₂-agonist and short-acting muscarinic antagonist

Combivent[®] Respimat[™] 20/100 mcg ipratropium bromide and albuterol 1238 C

COMBINATION MEDICATIONS

contain both inhaled corticosteroid and long-acting beta₂-agonist (LABA)

Advair Diskus[®] 100/50, 250/50, 500/50 mcg fluticasone propionate and salmeterol inhalation powder 1238 A C G	Advair[®] HFA 45/21, 115/21, 230/21 mcg fluticasone propionate and salmeterol xinafoate 1238 A G	AirDuo[®] Digihaler[™] 55/14, 113/14, 232/14 mcg fluticasone propionate and salmeterol inhalation powder 1238 A	AirDuo[®] RespiClick[™] 55/14, 113/14, 232/14 mcg fluticasone propionate and salmeterol inhalation powder 1238 A G	Breo[®] Ellipta[™] 100/25, 200/25 mcg fluticasone furoate and vilanterol inhalation powder 1238 A C	Dulera[®] 50/5, 100/5, 200/5 mcg mometasone furoate and formoterol fumarate dihydrate 1238 A	Symbicort[®] 80/4.5, 160/4.5 mcg budesonide and formoterol fumarate dihydrate 1238 A C G	Wixela[®] Inhub[™] 100/50, 250/50, 500/50 mcg fluticasone propionate and salmeterol xinafoate 1238 A C
--	--	--	---	--	--	--	---

COMBINATION MEDICATIONS

contain both long-acting beta₂-agonist (LABA) and long-acting muscarinic antagonist (LAMA)

Anoro[®] Ellipta[™] 62.5/25 mcg umeclidinium and vilanterol inhalation powder 1238 C	Besvespi Aerosphere[®] 5/4.8 mcg glycopyrrolate and formoterol fumarate 1238 C	Duaklir[®] Pressair[™] 400, 12 mcg aclidinium bromide and formoterol fumarate 1238 C
---	--	---

COMBINATION MEDICATIONS

contain inhaled corticosteroid, long-acting beta₂-agonist (LABA) and long-acting muscarinic antagonist (LAMA)

Trelegy[®] Ellipta[™] 200/62.5/25 mcg, 100/62.5/25 mcg fluticasone furoate, umeclidinium and vilanterol inhalation powder 1238 A C	Breztri Aerosphere[™] 160/9/4.8 mcg budesonide, glycopyrrolate and formoterol fumarate C
---	--

BIOLOGICS

target cells and pathways that cause airway inflammation; delivered by injection or IV

Cinqair[®] reslizumab A	Dupixent[®] dupilumab A	Fasenra[™] benralizumab A	Nucala[®] mepolizumab A	Tezpire[™] tezepelumab-ekko A	Xolair[®] omalizumab A
---	---	---	---	---	--

BRONCHIAL THERMOPLASTY

A minimally invasive procedure that uses mild heat to reduce airway smooth muscle, leading to fewer severe asthma flares, ER visits, and days lost from activities.
www.btrforasthma.com



Reviewed by Dennis Williams, PharmD ©2022 Allergy & Asthma Network

PDE4 INHIBITORS

ease lung inflammation and reduce oxalate carbons

Daliresp[®] 250, 500 mcg roflumilast C
--

Others

Oral steroids (i.e. prednisone) - asthma, COPD, ILD, sarcoidosis

Leukotriene inhibitors (i.e. montelukast) - allergic asthma

Antihistamines (loratadine, cetirizine, fexofenadine, diphenhydramine) - allergies/allergic asthma

PDE4-Inhibitor (roflumilast) - COPD with frequent exacerbations

Azithromycin - COPD with frequent exacerbations, bronchiectasis, CF

N-acetylcysteine (Mucomyst) neb - mucus plugging

7% saline nebs - bronchiectasis, CF

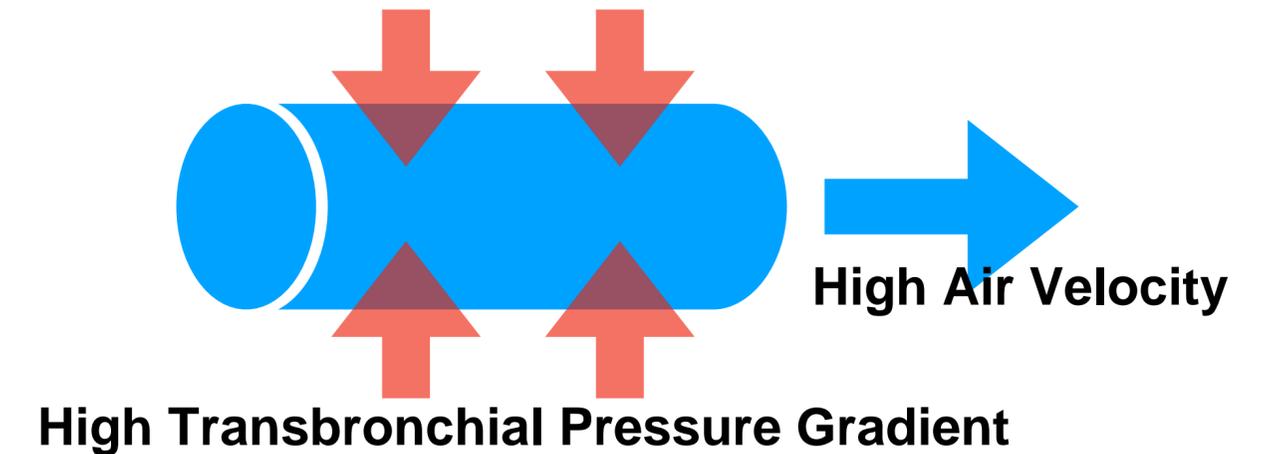
Biologics (omalizumab, dupilumab, benralizumab, mepolizumab) - severe asthma with frequent exacerbations

Tobramycin neb - CF, bronchiectasis with Pseudomonas infection

Airway Clearance

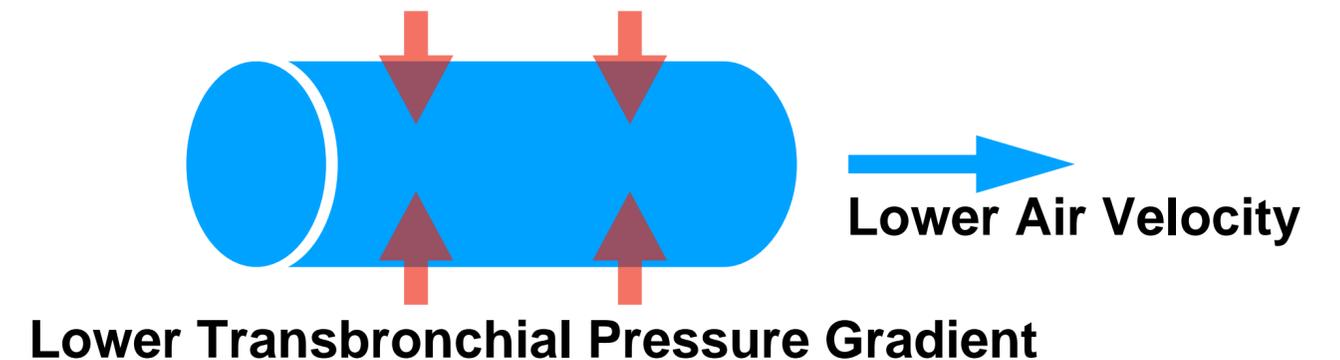
Conventional Cough - high pressure cough

- Good for clearing large airways
- High velocity airflow
- Airways tend to collapse due to high intrathoracic pressure and fast intraluminal airflow velocities —> smaller airways do not get cleared



Huff Coughing - low pressure cough

- Better for clearing smaller airways
- Lower velocity airflow
- Intrathoracic pressures are lower and intraluminal airflow velocities are lower in the smaller airways
- Less airway collapse during cough —> small airways are thus better cleared



Airway Clearance

Huff Coughing

- Sit up straight with chin tilted slightly up and mouth open.
- Take a slow deep breath to fill lungs about three quarters full.
- Hold breath for two or three seconds.
- Exhale forcefully, but slowly, in a continuous exhalation to move mucus from the smaller to the larger airways.
- Repeat this maneuver two more times and then follow with one strong cough to clear mucus from the larger airways.
- Do a cycle of four to five huff coughs as part of your airway clearance.

Airway Clearance

Oscillating Positive Expiratory Pressure (OPEP) Devices

High-Frequency Chest Wall Oscillation (HFCWO) for bronchiectasis, CF, frequent mucus plugging



Summary

Pulmonary Rehab is an individualized, comprehensive program that includes...

- Exercise program
- Education
- Disease self management

Pulmonary Rehab improves symptoms and quality of life, increase physical activity, and improve emotional health in patients with a variety of lung diseases. It is associated with a reduction in healthcare utilization and hospitalizations in COPD.