

Cardiopulmonary home exercise program

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ABSTRACT

Exercise provides significant benefits for individuals with cardiopulmonary disease. The traditional standard of care involves referring patients to specialized centers that offer cardiac or pulmonary rehabilitation programs. This approach is recommended internationally and is endorsed by the World Health Organization. However, use of these programs remains suboptimal. Multiple studies indicate that home-based exercise programs can also be highly beneficial for patients, with a very low incidence of adverse events. In this review, we outline a structured home exercise program for individuals with cardiopulmonary disease, incorporating exercises tailored to varying functional levels. In addition, we review key safety considerations and strategies for exercise recovery management. This program may serve as a valuable resource for both clinicians and patients.

Keywords: Home exercise program, cardiopulmonary disease, cardiopulmonary function, chronic, pulmonary disease, cardiac disease

INTRODUCTION

Global life expectancy has increased, accompanied by a rising prevalence of chronic disease. Consequently, a growing number of individuals are living longer with conditions such as chronic heart failure, chronic obstructive pulmonary disease (COPD), hypertension, and diabetes mellitus. Chronic heart failure and COPD commonly coexist, with reported prevalence estimates ranging from 20% to 32%.¹ Both populations are at significant risk of morbidity and mortality. Evidence indicates that each group develops alterations in skeletal muscle that contribute to reduced functional capacity.² The precise events and mechanisms underlying skeletal muscle atrophy remain incompletely understood; however, muscle disuse, chronic low-grade systemic inflammation, and elevated oxidative stress are thought to be key contributing factors.³

Cardiac and pulmonary rehabilitation have been shown to be beneficial for patients with chronic heart and lung disease. In their paper, “Benefits of Cardiac Rehabilitation,” Damluji et al. describe the origins of cardiac rehabilitation in the 1960s in the United States and Canada, where it was initially implemented as an inpatient program aimed at early mobilization following myocardial infarction.⁴ Over time, cardiac rehabilitation evolved into a predominantly outpatient model. A substantial body of evidence has since documented its clinical benefits.⁵ For patients with chronic lung disease, pulmonary rehabilitation is an evidence-based intervention that has been shown to improve symptoms, enhance functional capacity, and reduce hospital admissions.⁶ Despite the well-established benefits of both cardiac and pulmonary rehabilitation programs, they are underused. The reasons for this are multifactorial, and include barriers such as transportation difficulties, a limited number of available programs, and low referral rates. In their review of access to pulmonary rehabilitation, Malla et al. report that in the United States there is approximately one pulmonary rehabilitation center for every 6,030 individuals with chronic obstructive pulmonary disease.⁷ Several

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studies have investigated whether home-based programs provide benefits comparable to those delivered in center-based settings. In a comprehensive Cochrane Database review, Anderson et al. concluded that home- and center-based cardiac rehabilitation are similarly effective for patients following myocardial infarction or with heart failure.⁸ In addition, Bernocchi et al. evaluated the efficacy of an integrated, home-based telerehabilitation program in patients with both COPD and chronic heart failure, concluding that this approach is both feasible and effective.⁹ In this paper, we outline the implementation of a home-based exercise program.

BENEFITS OF CARDIOPULMONARY EXERCISE

There is a large benefit to exercise in individuals who have cardiopulmonary disease. It has been shown that exercise can “improve efficiency of the heart and lung function, speed up blood circulation, increase oxygen supply to the whole body, and improve elasticity of blood vessels. In addition, exercise can lower blood lipids and prevent arteriosclerosis and thrombosis.”¹⁰ It is important for health care providers to be aware of these benefits and to educate their patients on the benefits of exercise.

SAFETY CONSIDERATIONS

Multiple safety considerations should be considered when someone with a diagnosis of cardiopulmonary disease is exercising. A pulse oximeter can be used to intermittently check heart rate and oxygen saturation during exercise. Symptoms should be monitored throughout exercise, and exercise should be terminated when the following signs or symptoms occur: chest pain, hypertension (>250 mmHg systolic and >120 mmHg diastolic); fall in blood pressure >20 mmHg, O₂ saturation less than or equal to 80 percent, sudden pallor, loss of coordination, dizziness or faintness, signs of respiratory failure, mental confusion.¹¹ Patients should also have assistance from other individuals (friends, family, caregivers) as needed for balance or functional mobility. Assistive devices, counters, and chairs should be used as needed for safety to avoid falls during exercises.

EXERCISE RECOVERY MANAGEMENT

Individuals should ensure that O₂ saturation does not drop below 88 percent to prevent possible cell damage from hypoxia.¹⁶ The Rating of Perceived Exertion (RPE) scale, also known as the Borg Scale of Perceived Exertion, is used to understand how much effort patients perceive they are expending.¹⁵ The level of effort graded on the RPE 10-point scale should remain within goal levels. If the individual's exertion is outside of appropriate levels, the individual should rest until O₂ saturation is >88 percent and RPE levels have returned to 3–4 for moderate intensity or 5–7 for vigorous intensity.^{15,16} Techniques that have been used clinically for recovering O₂ saturation after physical activity include seated or standing rest. Pursed lip breathing and diaphragmatic breathing are also used for exercise recovery, which have been shown to increase O₂ saturation with COPD by enhancing alveolar ventilation and allowing for improved gas exchange.¹⁷

EXERCISE PARAMETERS

ENDURANCE TRAINING

Frequency & Duration: According to the AHA guidelines, it is recommended to complete 150-minutes of moderate intensity per week or 75-minutes of vigorous intensity per week of cardiovascular exercise. However, only 22.9 percent of American adults ages 18–64 meet these recommendations.¹² Therefore, it is advised that patients complete as much physical activity as possible, and that they feel is achievable for them. It may be helpful to begin with a small goal rather than asking them to complete 150-minutes per week.¹⁵

Intensity: Individuals should be educated on the 10-point RPE scale to ensure appropriate level of effort for exercise is completed. According to Mytinger et al., RPE of 11–14 is recommended on the –20 RPE scale, although using the 10-point RPE scale will likely be easier to understand and to explain.¹³ The individual can be advised to complete RPE of 3–4/10 for moderate intensity or 5–7/10 for vigorous intensity when using the 10-point RPE scale.¹⁵

Table 1. Home Exercise Program Example for Level 0 Patient

Exercise	Description	Intensity	Repetitions	Considerations
Supine Dead Bugs	Contralateral alternating shoulder flexion/elbow extension and hip/knee extension	RPE 3–4/10	3 sets × 15 reps	Go faster for increased difficulty
Snow Angels	Supine position. Shoulder and hip abduction/adduction with knees/elbows extended	RPE 3–4/10	3 sets × 15 reps	As above
Bridging	Elevating hips in supine with bent knees	RPE 3–4/10	3 sets × 15 reps	As above
UE strengthening	Supine shoulder flexion, shoulder extension, shoulder abduction, shoulder adduction, scapular retraction, elbow flexion, elbow extension	RPE 3–4/10	3 sets × 15 reps each; red theraband	This exercise is for strengthening, so speed should be controlled through the motion.
LE strengthening	Supine Hip flexion, hip abduction, hip adduction, knee flexion, knee extension, ankle pumps	RPE 3–4/10	3 sets × 15 reps each, red theraband	This exercise is for strengthening, so speed should be controlled through the motion.
Seated Edge of bed	To encourage upright tolerance. Assist patient as necessary.	Maintain O ₂ saturation >88 percent	2 hours	Ensure person has feet on floor and has posterior trunk support for balance as needed.
Standing Frame	Transfer patient to standing frame to encourage upright tolerance and pressure relief. Assist patient with transfer as necessary.	Maintain O ₂ saturation >88 percent	2 hours	Person should have adequate trunk control for standing frame. Standing frame should be properly adjusted for safety.

STRENGTH TRAINING

Strength training should be performed 2 non-consecutive days per week using multiple muscle groups and progressing to 3 days per week as able. The 10-point RPE scale should be used for assessing intensity, and levels should remain at 3–4/10. The individual should begin with 1 set per exercise and progress to 3 sets with 10–15 repetitions per set as tolerated.¹⁵

EXERCISES IN ASSOCIATION WITH PATIENT FUNCTIONAL LEVEL

A wide variety of functional differences exist in the cardiopulmonary population. Some individuals can

walk long distances without assistance, and some individuals may need assistance from others to get out of bed and/or require assistive devices (AD) for their mobility. The following section will cover cardiopulmonary exercise possibilities at all levels of mobility and function. Home exercise programs should be tailored to individuals and their functional levels by licensed clinicians.

Level 0: Bed-bound. Patients may have reduced mobility that prevents them from mobilizing out of bed without assistance and/or may have low O₂ saturation upon sitting that prevents progression to standing. Goal for these patients is assisting them to achieve an upright position

as this is the best position for improved pulmonary function for patients with cardiopulmonary disease.¹⁴

- **Safety:** An additional person should be present for assistance if necessary, appropriate body mechanics and equipment should be used for safe transfers, and oxygen saturation should be monitored with pulse oximeter.
- **Supine:**
 - Can complete bridging, rolling, AROM/AAROM/PROM/RROM of all UE and LE joints into multiple planes of motion.
 - Can use isolated joint movements and progress to a combination of joint movements. Theraband can be added for further progression using resistance.
- **Raising head of bed or propping patient to upright sitting with pillows.** Can advance patient from reclined position (45 degrees) to upright sitting (90 degrees). If patients can tolerate 90 degrees of trunk elevation, they will likely tolerate sitting on edge of bed. Oxygen saturation should be closely monitored in each of these positions.
- **Sitting on edge of a bed or in a chair:** Patients who are bed-bound would benefit from upright sitting to improve cardiopulmonary function and for position changes for pressure relief. If patients are able to tolerate sitting edge of bed for 1- or 2-hours without reduced O₂ saturation; it would also be beneficial for them to be transferred using appropriate assistance or equipment to supportive chairs with backrests and armrests.
- **Standing frame:** For upright tolerance and pressure relief as well. Ensure O₂ saturation is adequate and recheck intermittently in transitioning from seated to full standing position. Blood pressure should be monitored as well to monitor for orthostatic hypotension. Ensure someone remains with the patient while in a standing frame to monitor tolerance and to assist in adjusting for comfort as needed.

Level I: Wheelchair to Standing. For patients who predominantly use wheelchairs for their mobility but can complete transfers or stand with or without

additional assistance. For patients who may stand to complete Activities of Daily Living (ADL) but are unsafe or unable to walk.

- **Safety:** Monitor O₂ saturation, use AD as needed, use additional person for assistance as needed
- **Seated exercises:** AROM/AAROM/PROM/RROM of all upper and lower extremity (UE, LE) joints into multiple planes of motion. Can complete combination of motions of multiple joints into multiple planes for whole-body involvement and cardiopulmonary usage.
- **More activity examples:**
 - **Wheelchair mobility:** Use wheelchair with arms and legs to go forward and backward in figure 8 pattern; if there is limited space available can do this also in straight line.
 - **Wheelchair Press ups:** Ensure wheelchair is locked. Press through hands on armrests and feet on floor to lift bottom off of seat.
 - **Sit to stand transfers:** Standing and sitting from wheelchair with no upper extremity support, or with use of assistive device as necessary.
 - **Pivot Transfers:** Pivoting back and forth from wheelchair to standard chair; use assistive device or armrests as needed.

Level II: Standing to walking small distances (<50 ft). For patients who can stand and walk short distances with or without assistive device(s).

- **Safety:** Individuals should use balance support such as a counter, assistive device, or additional person for assistance; chairs can be placed behind them as well. Monitor oxygen saturation.
- **Standing:** AROM/AAROM/PROM/RROM of all UE and LE joints into multiple planes of motion. Can complete combination of motions of multiple joints into multiple planes for whole-body involvement and cardiopulmonary use.
- **More Activity Examples:** Sit to stands, walking, lateral steps, step taps

Table 2. Home Exercise Program Example for Level I Patient

Exercise	Description	Intensity	Repetitions	Considerations
Seated alternating marches with contralateral shoulder flexion	Seated, flex hip with simultaneous flexion of contralateral shoulder with elbow extended	3–4/10 RPE	3 sets × 15 reps	Can complete quickly to increase difficulty
Seated snow angels	Seated alternating hip and shoulder abduction/adduction; knees bent and elbows extended	3–4/10 RPE	3 sets × 15 reps	Can complete quickly to increase difficulty
Sit to stand transfers with clap	Sit to stand transfers with clap overhead upon standing	3–4/10 RPE	3 sets × 15 reps	Can complete quickly to increase difficulty or can complete slowly to focus on strengthening. To make it more difficult, stand from a lower surface.
UE strengthening	Seated shoulder flexion/extension/abduction/adduction, elbow flexion/extension	3–4/10 RPE	3 sets × 15 reps, red theraband	Focus is on strengthening for this set of activities; complete at controlled pace.
LE strengthening	Seated hip flexion/abduction, hip adduction, knee flexion/extension, Ankle pumps	3–4/10 RPE	3 sets × 15 reps, red theraband for all exercises except hip adduction. Hip adduction: use pillow between knees and squeeze; hold for 6 seconds	Focus is on strengthening for this set of activities; complete at controlled pace
Wheelchair mobility	Use legs and arms to mobilize wheelchair down hallway	3–4/10 RPE	10–30 mins; as tolerated	Increase speed to make activity more difficult. Can also go up an incline to increase difficulty

Level III: Walking Large Distances (>50 ft). For patients who are able to leave their houses and walk in the community with or without assistive device; patients who are relatively sedentary.

- *Safety:* Use AD as needed, monitor O₂ saturation
- *Standing:* AROM/AAROM/PROM/RRROM of all UE and LE joints into multiple planes of motion. Can complete combination of motions of multiple joints

into multiple planes for whole-body involvement and cardiopulmonary use.

- *More activity examples:* Squats, walking forward/backward, lateral walking, step ups

Level IV: Advanced. Individuals who exercise regularly or are independent, do not use an assistive device, and require no functional assistance. For this population it will be important for them to select what forms

Table 3. Home Exercise Program Example for Level II Patient

Exercise	Description	Intensity	Repetitions	Considerations
Sit to stand with intermittent marching	Stand from sitting, complete two marches and then return to sitting and repeat	3–4/10 RPE	3 sets × 15 reps	Use AD/counter support
4-way hip	Hip flexion, hip abduction, hip adduction, hip extension	3–4/10 RPE	No resistance. 3 sets × 15 reps	To improve strength. Use AD/Counter support. Can add theraband for increased strengthening.
Heel raises	Raise heels off of floor in standing position	3–4/10 RPE	3 sets × 15 reps	To improve strength. Use AD/Counter support
UE strengthening	Standing shoulder flexion/extension/abduction/adduction; elbow flexion/extension	3–4/10 RPE	3 sets × 15 reps; red theraband	Complete while seated if balance is not adequate for standing without UE support.
Square stepping	Step forward, backward, and sideways each direction	3–4/10 RPE	No resistance. 3 × 15 reps (1 step each direction is 1 repetition)	Use AD as needed. Can add theraband for improving strength.
Walking	Walk as far as tolerated.	3–4/10 RPE	Aim for 30 feet at a time if possible; walk with seats nearby in case rest break is needed.	Use AD as needed. Monitor O2 saturation.

of physical activity they enjoy and would be willing to complete frequently.¹⁵ It is important to educate lifestyle changes that can be made so that they can maintain or improve their current functional status. This population should be encouraged to complete endurance activities for most days of the week for a total of 150 minutes of moderate intensity exercise or 75-minutes of vigorous exercise if possible, as well as strengthening exercises at least 2 days per week. If individuals are starting from sedentary lifestyles and beginning to exercise for the first time, they may be more compliant with the program starting with smaller amounts of activity in the beginning of the program and working up to a goal of meeting AHA guidelines as they progress.¹²

- *Strengthening examples:* lateral raises, rows, latissimus dorsi pull downs, chest press, bicep curls,

triceps extensions, leg press, knee extension, knee flexion, heel raises, squats

- *More activity examples:* Stairs, burpees, treadmill or stationary bike, brisk outdoor walking, swimming, lunges, jumping jacks

DISCLOSURE STATEMENT

Home exercise programs should be developed by a licensed medical professional with consideration of the individual's medical status. Clinical reasoning/judgment is essential to the formulation and execution of a home exercise program. The exercises listed are guidelines and are not the only exercises possible to complete. The authors of this article will not be held liable for any injuries obtained from using information from the above listed programs.

Table 4. Home Exercise Program Example for Level III Patient

Exercise	Description	Intensity	Repetitions	Considerations
Walking marches with alternating shoulder flexion to 90 degrees	Hip flexion plus knee flexion with contralateral shoulder flexion with elbow extension simultaneously	3–4/10 RPE	3 sets × 15 reps; 5# weights in hand	Can eliminate upper extremity component if AD is needed for balance.
Lateral walks with resistance plus shoulder press	Lateral stepping; shoulder press when feet are apart	3–4/10 RPE	3 sets × 15 reps; 5# weights in hand; red theraband around ankles	Can eliminate upper extremity component if AD is needed for balance.
4-way hip with resistance	Hip flexion, hip extension, hip adduction, hip abduction	3–4/10 RPE	3 sets × 15 reps; red theraband around ankles	AD or counter support for balance. Completed for strengthening
Squats	Feet shoulder width apart, squat to 90 degrees of knee flexion and hip flexion.	3–4/10 RPE	3 sets × 15 reps	Completed for strengthening. Can add weight to hands to progress. Use AD or counter support as needed.
UE strengthening	Shoulder flexion/extension/abduction/adduction, elbow flexion/extension	3–4/10 RPE	3 sets × 15 reps; red theraband	Complete in seated if standing balance without AD is impaired.
Resisted walking	Walk forward/backward for 20 feet each direction; use AD as needed. Maintain equal step length going forward and backward	3–4/10 RPE	20 feet, 5x; Red theraband around ankles	Use AD as necessary for balance.

Table 5. Home Exercise Program Example for Level IV Patient

Exercise	Description	Intensity	Repetitions	Considerations
The following exercises should be completed as a circuit activity:				
Jumping Jacks	Can complete components of activity with stepping if jumping is difficult	3–4/10 RPE	3 sets × 15 reps each	This should be completed with rest breaks as needed and should be terminated after the desired amount of time for exercise. Aim for 20–30 minutes total.
Step ups	Can use curb outdoors			
Burpees	Can complete slowly as needed. Can eliminate components of burpee that are challenging and modify as needed.			
Squats	Can use weight in hands if able			
Strengthening Exercises: It is advised that these patients complete resistance exercise program consisting of multiple muscle groups at least 2 non-consecutive times per week, 3 sets × 10–15 reps each exercise. ¹⁵				

CONCLUSION

Overall, patients' home exercise programs should be tailored toward their specific activity levels. The standard recommendations for improving cardiopulmonary fitness may be difficult for patients to achieve, and they should be advised to do as much physical activity as they can.¹⁵ Safety considerations are very important in the cardiopulmonary population, and vital signs/symptoms should always be monitored with exercise. There are many different levels of function across the cardiopulmonary population, and these levels should be considered when forming home exercise programs. A home exercise program can be generated for a patient in many ways; the ones provided in this article are examples of each mobility level category, but each program should be adjusted to the specific individual. The exercises listed underneath each category are not all inclusive.

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