

# Telehealth Pulmonary Rehabilitation for Patients With Severe Chronic Obstructive Pulmonary Disease

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For patients with chronic obstructive pulmonary disease, a home-based, interactive telehealth program can improve accessibility to pulmonary rehabilitation and reduce travel costs.

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According to World Health Organization estimates, 65 million people have moderate-to-severe chronic obstructive pulmonary disease (COPD) globally, and > 20 million patients with COPD are living in the US.<sup>1</sup> COPD is a progressive respiratory disease with a poor prognosis and a significant cause of morbidity and mortality in the US, especially within the Veterans Health Administration (VHA).<sup>2</sup> The prevalence of COPD is higher in veterans than it is in the general population. COPD prevalence in the adult US population has been estimated to be between 5% and 15%, whereas in veterans, prevalence estimates have ranged from about 5% to 43%.<sup>3-5</sup>

COPD is associated with disabling dyspnea, muscle weakness, exercise intolerance, morbidity, and mortality. These symptoms and complications gradually and progressively compromise mobility, ability to perform daily functions, and decrease quality of life (QOL). Dyspnea, fatigue, and discomfort are the principal symptoms that negatively impact exercise tolerance.<sup>6,7</sup> Therefore, patients often intentionally limit their activities to avoid these uncomfortable feelings and adopt a more sedentary behavior. As the disease progresses, individuals with COPD will gradually need assistance in performing activities of daily living, which eventually leads to functional dependence.

Pulmonary rehabilitation (PR) is an essential component of the management of symptomatic patients with COPD. PR is an evidence-based, multidisciplinary, compre-

hensive intervention that includes exercise and education for patients with chronic respiratory disease.<sup>8</sup> The key benefits of PR are clinical improvements in dyspnea, physical capacity, QOL, and reduced disability in patients with COPD and other respiratory diseases.<sup>9-11</sup> PR was found to improve respiratory health in veterans with COPD and decrease respiratory-related health care utilization.<sup>12</sup>

Despite the known benefits of PR, many patients with chronic respiratory diseases are not referred or do not have access to rehabilitation. Also, uptake of PR is low due to patient frailty, transportation issues, and other health care access problems.<sup>13-15</sup> Unfortunately, in the US health care system, access to PR and other nonpharmacologic treatments can be challenging due to a shortage of available PR programs, limited physician referral to existing programs, and lack of family and social support.<sup>16</sup>

There are only a few accredited PR programs in VHA facilities, and they tend to be located in urban areas.<sup>12,17</sup> Many patients have limited access to the PR programs due to geographic distance to the programs and transportation challenges (eg, limited ability to drive, cost of transportation). Moreover, veterans with COPD are likely to have limited mobility or are homebound due to experiencing shortness of breath with minimal exertion. Given the clear benefits of PR and the increasing impact of COPD on morbidity and mortality of the patients with COPD, strategies to improve the access and

capacity of PR are needed. VA telehealth services allow for distribution of health care services in different geographic locations by providing access for the veterans who live in rural and highly rural areas. The most recent implementation of VA Video Connect (VVC) by the VHA provides a new avenue for clinicians to deliver much needed medical care into the veterans' home.

### **COPD TELEHEALTH PROGRAM**

In this article, we describe the processes for developing and delivering an in-home, interactive, supervised PR program for veterans with severe COPD through VA telehealth service. The program consists of 18 sessions delivered over 6 weeks by a licensed physical therapist (PT) and a respiratory therapist (RT). The aims of the telehealth PR are to improve exercise tolerance, reduce dyspnea and fatigue, improve QOL, improve accessibility, and decrease costs and transportation burdens for patients with COPD. The program was developed, implemented and delivered by an interdisciplinary team, including a pulmonologist, PT, RT, psychiatrist, and nonclinical supporting staff.

#### **Patient Assessment**

To be eligible to participate in the program the patient must: (1) have a forced expiratory volume (FEV<sub>1</sub>) < 60%; (2) be medically stable and be receiving optimal medical management; (3) have no severe cognitive impairments; (4) be able to use a computer and e-mail; (5) be able to ambulate with or without a walking device; (6) be willing to enroll in a smoking cessation program or to stop smoking; (7) be willing to participate without prolonged interruption; and (8) have all visual and auditory impairments corrected with medical devices.

After referral and enrollment, patients receive medical and physical examinations by the PR team, including a pulmonologist, a PT, and a RT, to ensure that the patients are medically stable to undergo rehabilitation and to develop a tailored exercise program while being mindful of the comorbidities, limitations, and precautions, (eg, loss of balance, risk of fall, limited range of motion). The pre-program assessment includes a pulmonary function test, arterial blood gas test, Montreal Cognitive Assessment, Modified Medical Re-

search Council Scale, St. George Respiratory Questionnaire, the COPD Assessment Test, Patient Health Questionnaire-9, Generalized Anxiety Disorder Assessment-7, Epworth Sleepiness Scale, Katz Index of Independence of Activities of Daily Living, medications and inhaler use, oxygen use, breathing pattern, coughing, 6-minute walk test, Modified Borg Dyspnea Scale, grip strength, 5 Times Sit to Stand Test, manual muscle test, gait measure, Timed Up & Go test, clinical balance tests, range of motion, flexibility, sensation, pain, and fall history.<sup>18-32</sup> Educational needs (eg, respiratory hygiene, nutrition, infection control, sleep, disease/symptom management) also are evaluated.

This thorough assessment is performed in a face-to-face outpatient visit. During the program participation, a psychiatrist may be consulted for additional needs (eg, wheelchair assessment, home safety evaluation/modifications, and mobility/disability issues). After completing the 6-week program, patients are scheduled for the postprogram evaluation in a face-to-face outpatient visit with the clinicians.

#### **Equipment**

Both clinician and the patient are equipped with a computer with Wi-Fi connectivity, a webcam, and a microphone. Patients are provided an exercise pictorial booklet, an exercise compact disk (audio and video), small exercise apparatuses (eg, assorted colors of resistance bands, hand grip exerciser, hand putty, ergometer, harmonica, and pedometer), incentive spirometer, pulse oximeter, cough assistive device (as needed), blood pressure monitor, COPD information booklets, and a diary to use at home during the program.<sup>33</sup>

#### **Technology Preparation**

Prior to starting the telehealth program, the patient is contacted 1 or 2 days before the first session for technical preparation and familiarization of the VA telehealth connection process. Either the PT or RT provides step-by-step instructions for the patient to practice connecting through VVC during this preparatory phone call. The patient also practices using the computer webcam, speaker, and microphone; checks the telehealth scheduling e-mail; and learns how to solve possible common technical issues

**FIGURE 1** Remote Monitoring of a Patient Performing a Strengthening Exercise



(eg, adjusting volume and position of webcam). The patient is asked to set up a table close to the computer and to place all exercise apparatuses and respiratory devices on the table surface.

### Program Delivery

A secure online VVC is used for connection during the telehealth session. The patient received an e-mail from the telehealth scheduling system with a link for VVC before each session. During the 6-week program, each telehealth session is conducted by a PT and a RT concurrently for 120 minutes, 3 days per week. The PT provides exercises for the patient to attempt, and the RT provides breathing training and monitoring during the session. After a successful connection to VVC, the therapist verifies the patient's identity and confirms patient consent for the telehealth session.

After this check-in process, the patient performs a self-measure of resting blood pressure (BP), heart rate, respiratory rate, and blood oxygen saturation and reports to the therapists. During the exercise session, fatigue/exertion, dyspnea (Modified Borg Dyspnea Scale; Borg CR10 Scale), BP, heart rate, oxygen saturation, and other clinical symptoms and responses to exercise are monitored by the therapists, using both patient-reported measures and clinical observation by the therapists.<sup>34,35</sup> Any medical emergency during the session is reported

immediately to the pulmonologist for further management.

### Structure

Prior to each exercise session, exercise precautions, fall prevention, good posture, pursed-lip breathing, pacing, and coordinated breathing are discussed with the patient. The PT demonstrates stretching and warm-up exercises in front of the webcam for the patient to follow. Then the patient performs all exercises in view of the webcam during the session (Figure 1). A RT monitors breathing patterns and corrects with verbal instructions if not properly performed.

Loss of skeletal muscle mass and cachexia are highly prevalent comorbidities of COPD and have been associated with breathlessness, functional limitation, and poor prognosis.<sup>36</sup> To address these comorbidities, our program consists of progressive strengthening, aerobic, balance, and flexibility exercises. Resistance bands and tubes are used for strengthening exercises. Callisthenic exercises (eg, chair squat, chair stand, knee marching, bridging, single limb stances, and lunge) are used for progressive strengthening and balance exercises. Progression of strengthening and balance exercises are done through increasing the volume of exercise (ie, numbers of sets and repetitions) and increased load and level of difficulty based on the patient's progress and comorbidity. The exercise program focuses on strengthening muscles, especially large muscle groups, to improve overall muscle strength and performance of functional activities.<sup>37</sup>

Arm/pedal ergometer and daily walking are used for daily aerobic exercise. In a study of patients with COPD by the PAC-COPD Study Group, step counter use was found to increase physical activity and improve exercise capacity, which supports its use in COPD management.<sup>38</sup> During program participation, the patient is asked to wear a pedometer to monitor the number of steps taken per day and to report step data to the therapists during the telehealth session. The pedometer stores the previous 41 calendar days of data and displays the most recent 7 calendar days of data.

The patient is encouraged to set a realistic daily step goal. The general program goal is to increase at least 1000 steps per day. However,

this goal can be adjusted depending on the patient's health status and comorbid conditions. The PAC-COPD Study Group found that for every additional 1000 daily steps at low intensity, COPD hospitalization risk decreased by 20%.<sup>39</sup> A magnitude of 2000 steps or about 1 mile of walking per day was found to be associated with increased physical activity and health benefits in the general population.<sup>40</sup>

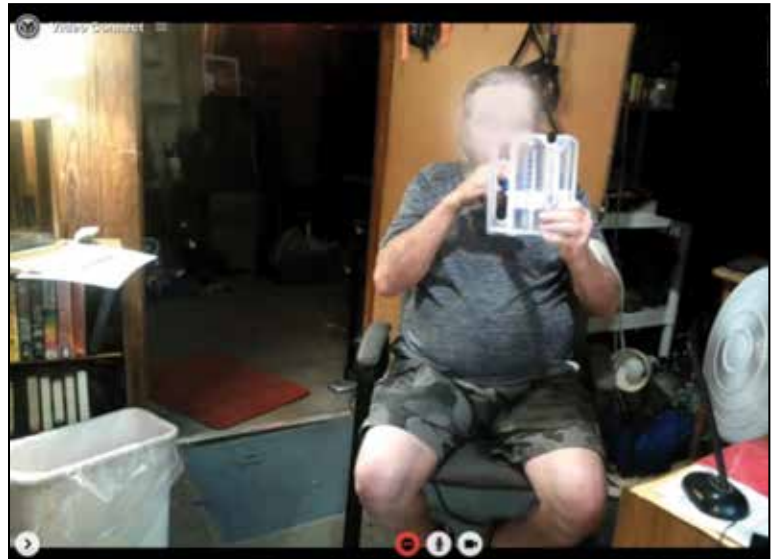
Respiratory muscle training and breathing exercise are provided by the RT, using breathing and incentive spirometer techniques (Figure 2). Huff coughing, diaphragmatic deep breathing, and pursed-lip breathing are instructed by the RT during the session. Effective coughing technique with a cough assistive device is also provided during breathing training if needed.

### Patient Education

In patients with COPD, there are numerous positive health benefits associated with education, including assisting the patients to become active participants in the PR program leading to satisfying outcomes; assisting the patients to better understand the lung health, disease processes, physical and psychological changes that occur with COPD; assisting the patients to explore coping strategies for those changes; building lifelong behavioral changes; and developing the self-management skills for sustainability. Through the educational process, patients with COPD can become more skilled at collaborative self-management and improve adherence to their treatment plan, which in turn can result in a reduction in hospital admissions and reduced health care costs.<sup>8,41</sup>

Education is provided with every session after the patient completes the exercise. Patients are required to record their COPD symptoms, daily activity, home exercise program, sleep, food intake, and additional physical or social activity in their COPD diary and to report during the session (Figure 3). A COPD diary assists patients in self-monitoring their COPD symptoms and provides the therapists with information about clinical changes, behavioral changes, and/or specific unmet needs for education. Several topics related to COPD are included in the education session: lung or respiratory disease/condition and self-management; smoking cessation; physical activity; energy-

**FIGURE 2** Remote Monitoring of a Patient Performing a Respiratory Exercise



conserving techniques; breathing and coughing techniques; smoking cessation; nutrition/healthy eating and weight counseling; sex and intimacy; psychological counseling and/or group support; emergency planning (eg, medical, travel, and inclement weather); correct use of inhaler and medications; home oxygen; sleep and sleep hygiene; palliative care and advanced directive; infection control; and sputum clearance.<sup>42,43</sup>

### Program Maintenance

After successfully completing the 6-week program, patients are referred to the VA TeleMOVE! Program or MOVE! Weight Management Program for continuous, long-term management of weight, nutrition, physical activity/exercise, and social activity needs or goals. The patients are scheduled for monthly follow-up phone visits for 6 months with the telerehabilitation team for enforcing sustainability. The phone call visit consists of reviewing breathing techniques, exercise program, physical activity, education, encouragement, and addressing any issues that arise during the self-maintained period.

### Limitations

There are several issues of concern and precautions when delivering PR through telehealth into the home. First, the patient performs exercises independently without



**FIGURE 3** Telehealth-Based Patient Education

being manually guarded by the therapists. Risk of falls are a major concern due to impaired balance, poor vision, and other possible unusual physiologic responses to exercise (eg, drop in BP, dizziness, loss of balance). The area in front of the computer needs to be cleared of fall hazards (ie, area rug, wires, objects on the floor). The patient also needs to be educated on self-measurements of BP and oxygen saturation and reports to the therapists. The therapists provide detailed instructions on how to obtain these measures correctly; otherwise, the values may not be valid for a clinical judgment during the exercise session or for other clinical management. In a home environment, there is a limited use of exercise apparatuses. For this program, we only used resistance bands/tubes, small arm/leg ergometer, hand grip, and hand putty for the exercise program. We feel that dumbbell and weight plates are not suitable due to a possible risk of injury if the patient accidentally drops them.

Advanced balance training is not suitable due to an increased risk for falls. Without the presence of the PT, level of challenge/difficulty is somewhat limited for this telehealth supervision exercise program. In addition, visual and audio quality are necessary for the session. The patient and the therapists need to see each other clearly to ensure correct methods and forms of each exercise. Furthermore, rehearsal of technical skills with the therapists is very important because this population is older and often has limited com-

puter skills. Any technical difficulty or failure can lead to undesirable situations (eg, anxiety episodes, worries, shortness of breath, upset), which compromise exercise performance during the session. Finally, a phone is needed as an alternative in case of a poor VVC connection.

## CONCLUSION

COPD symptoms and complications greatly affect patients' ability to perform daily activities, decrease QOL and functional ability, and result in extensive use of health services. Many patients have limited access to a PR program at hospitals or rehabilitation centers due to health conditions, lack of transportation, and/or family support. This home-based, interactive telehealth PR program can break down the geographic barriers, solve poor program accessibility, potentially increase the utilization of PR, and reduce the cost and travel required by the patients.

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## Author disclosures

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## Disclaimer

The opinions expressed herein are those of the authors and do not necessarily reflect those of *Federal Practitioner*, Frontline Medical Communications Inc., the US Government, or any of its agencies.

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