Implementation and Outcomes of a Community-Based Pulmonary Rehabilitation Program in Rural Appalachia

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Purpose: To report on the implementation and clinical outcomes of a community-based pulmonary rehabilitation program in rural Appalachia.

Methods: Three rural health centers and a large referral hospital worked together to establish pulmonary rehabilitation services based on AACVPR guidelines. Each site hired at least 1 respiratory therapist. To measure clinical outcomes, a retrospective medical record study compared pre- and post-program values for the modified Medical Research Council dyspnea level, 6-minute walk test (6MWT), negative inspiratory force (NIF), respiratory disease knowledge, St George Respiratory Questionnaire (SGRQ), BODE index (body mass index, airflow obstruction, dyspnea and exercise capacity), and smoking status. The percentages of persons completing the program and participating in maintenance exercise after the program were recorded.

Results: During the first 20 months of the program, 195 unduplicated persons with qualifying chronic lung diseases started the program. Of these, 111 (57%) completed the program. Mean improvements for all 6 measures were highly significant ($P < .001$) and compared favorably with published results from hospital-based programs: dyspnea level, −1.2; 6MWT, +259 ft; NIF, +11.3 cm H_2O; knowledge test, +1.9; SGRQ, −6.2; BODE index, −1.1. Of the 23 smokers, 5 quit by the end of the program.

Conclusions: Community-based pulmonary rehabilitation in rural health centers is feasible and achieves clinical outcomes similar to programs in large hospitals and academic centers. Furthermore, the addition of respiratory therapists to these primary care teams provides important collateral benefits for the evidence-based care of patients with chronic lung diseases.

Key Words: community-based services • federally funded qualified community health center • primary care • pulmonary rehabilitation • rural

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the United States and the sixth leading cause in the world.[1,2] COPD affects 15 million (6%) of US adults and many more worldwide.[2] Costs in lost productivity and medical services are high, with direct annual costs of $30 billion in the United States and €38 billion for Europe.[2] Pulmonary rehabilitation (PR) programs combine defined education modules and exercise training over a period of 12 weeks and 24 sessions.[3] PR improves quality of life, exercise capacity, and dyspnea levels for persons with COPD of moderate severity or greater.[4-7] PR also benefits persons with other types of chronic lung disease.[8] Numerous expert guidelines recommend PR for persons with COPD and other chronic lung diseases.[2,9-11]

Despite this evidence and these expert recommendations, PR is severely underutilized.[9,10] Fewer than 20% of persons with COPD enter and complete PR programs in the United States.[12] There are many reasons for this unfortunate health care gap including poor reimbursement levels, lack of awareness by primary care providers, and lack of available programs in many communities.[12] Access to programs is limited, especially in rural areas, due to geographic isolation and transportation barriers. This study describes the development and results of a PR program carried out by a network of rural primary care centers in the Appalachian region of North America.

MATERIALS AND METHODS

PROJECT BACKGROUND AND HISTORY

In 2012, a family foundation and a US Senator approached a federally qualified community health center (FQHC) in West Virginia and proposed the establishment of PR programs in multiple rural communities. This proposal grew out of the personal experience and commitment of the foundation directors. The leadership of the health center identified 3 rural health centers and an academic tertiary care center as clinical partners for this program. They also recruited 5 entities to provide the matching funds as required by the family foundation. The FQHC, a nonprofit corporation, served as the grantee and fiscal agent for this effort. In August 2013, the pooled funds became available and the Grace Anne Dorney Pulmonary Rehabilitation Project of West Virginia (GADPRP) began.

Three sites were invited to participate in the program, 2 FQHCs and 1 critical access rural hospital. All signed a memorandum of agreement to provide services according to the program model. That model followed the AACVPR guidelines for pulmonary rehabilitation, which includes staffing by a registered respiratory therapist, 12 weeks and 24 sessions of education and exercise, coverage of 8 core educational topics, assessment and attention to psychosocial and nutritional issues, encouragement of continued exercise (maintenance) after program completion, and ongoing program evaluation.[3]

Program startup at all 3 sites included creating space, recruitment and hiring of respiratory therapists and other staff, identifying supervising physicians, purchase of exercise

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All authors have read and approved the manuscript.

The authors declare no conflicts of interest.

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DOI: 10.1097/HCR.0000000000000247

equipment, purchase of educational materials, and preparation of policies.[13] Administrative staff had to prepare budgets, arrange liability coverage, and quickly learn about billing codes and procedures. Before the first participants were enrolled, respiratory therapists and support staff from the 3 sites began meeting to agree on definitions, protocols, and evaluation procedures. An experienced respiratory therapist from the tertiary care hospital's PR program attended these meetings and had the therapists come to the hospital to learn PR procedures. With this support and preparation, the GADPRP began enrolling and conducting rehabilitation sessions with the first participants on November 1, 2013. This study was approved by the Charleston Area Medical Center Institutional Review Board as a retrospective medical records study and was exempted from obtaining signed informed consent.

THE GRACE ANNE DORNEY PULMONARY REHABILITATION PROGRAM

Persons were referred by primary care providers, community physicians, and pulmonologists. Persons with all qualifying chronic lung disease diagnoses were accepted including COPD, restrictive lung diseases, pneumoconiosis, asthma, cystic fibrosis, and pulmonary hypertension. Prior to beginning exercise, participants had a medical history review, medication review, chest x-ray, spirometry, electrocardiogram, and examination by a physician affiliated with the program. An individual treatment program and exercise prescription was completed collaboratively by the respiratory therapist and program physician.

Once the screening was completed, baseline clinical measures were obtained including a modified Medical Research Council (mMRC) dyspnea level, 6-minute walk test (6MWT), negative inspiratory force test (NIF), lung disease knowledge test, St George Respiratory Questionnaire (SGRQ), and BODE (body mass index, airflow obstruction, dyspnea and exercise capacity) index. Each patient then completed a 12-week, 24-session program of graded exercise and education. Due to exacerbations, comorbidities, or other life problems, it often required longer than 12 weeks to complete all 24 sessions. At the time of program completion, the 6 baseline assessments including mMRC, 6MWT, NIF, knowledge test, SGRQ, and BODE index were repeated. The program graduate was then invited and encouraged to attend a supervised maintenance exercise program weekly at the rehabilitation center for a nominal fee.

DATA MANAGEMENT AND STATISTICAL ANALYSIS

Measures of program activity and completion were recorded by each site throughout the program. On a quarterly basis, "snapshot" assessments were completed for the mutually exclusive categories of *Active*, *Approved/on-hold*, *Graduated,* and *Discharged*. The categories *Graduated* and *Discharged* were reset to zero at the end of each calendar year.

Business associate agreements existed between the 3 sites and the research institute of the tertiary care hospital partner. For each participant, demographic data, vital signs, pre- and post-clinical measures were entered into the clinical care coordination software (CAPGate). CAPGate.org is a HIPAA-compliant secure Internet Web site maintained and supported by Partners in Health Network of Southern West Virginia.[14] CAPGate allows for the integrated tracking of primary care, care coordinator interventions, and hospital utilization data. For the research protocol these records were de-identified.

All analyses were performed using SPSS version 19.0 (IBM, Armonk, NY). Descriptive statistics are expressed in terms of frequencies, percentages, or means (1 standard deviation). Paired samples *t* tests were used to compare pre- and post-PR physiologic and psycho-educational measures. A P value $\leq .05$ was considered significant. Where deemed appropriate, possible variable interactions and measures of minimal important difference were used to evaluate outcomes.

RESULTS

PROGRAM PARTICIPATION AND GRADUATION RATES

There were a total of 195 unduplicated persons who enrolled in the GADPRP between November 1, 2013, and June 30, 2015. Of these, 111 completed the program (graduated) for an overall completion rate of 57%. Reasons for dropout included exacerbations of pulmonary illness, complications of other illnesses, loss of mobility, expense, transportation, and death.

Graduation rates varied among the 3 sites with rates of 51%, 70%, and 48% at sites 1, 2, and 3, respectively ($P < .015$). Possible reasons for this difference included variation in patient selection, transportation barriers, staffing ratios, staff personalities and motivation, and respiratory therapist job descriptions and responsibilities within their respective institutions.

CLINICAL OUTCOMES FOR GRADUATES

Table 1 shows clinical outcomes for the 111 program graduates. There were significant improvements in all 6 outcome measures ($P < .001$). These included 6MWT, +259 ft; BODE index, −1.1; mMRC dyspnea level, −1.2; NIF, +10.5 mm Hg; SGRQ, −6.2; and knowledge score, +1.9. Knowledge scores and NIF data were not used from site 3 because, during the evaluation, the methods were found to be invalid. Five of the 23 smokers quit during the

Table 1

Clinical Outcomes for Patients Who Completed PR Program (n = 111)

	Pre-PR	Post-PR	Mean Change ± SD	95% CI	*P* Value
Dyspnea level, mMRC	3	1.8	−1.2 ± 1.1	−1.39 to −1.01	<.001
6-min walk test, ft	760	1019	259 ± 238.2	214 to 304.44	<.001
NIF, cm H_2O[a]	78.2	88.7	10.5 ± 19.5	5.89 to 15.15	<.001
Knowledge test score[a]	15.8	17.7	1.9 ± 2.4	1.33 to 2.49	<.001
SGRQ	54.6	48.4	−6.2 ± 14.4	−8.88 to −3.46	<.001
BODE index	3.4	2.3	−1.1 ± 1.1	−1.29 to −0.86	<.001

Abbreviations: BODE, body mass index, airflow obstruction, dyspnea and exercise capacity; mMRC, modified Medical Research Council; NIF, negative inspiratory force test; PR, pulmonary rehabilitation; SGRQ, St George Respiratory Questionnaire; SD, standard deviation.

[a]NIF and knowledge test data were from sites 1 and 2 only because measurement technique was not valid at site 3 for these measures.

Table 2

Comparison of Pulmonary Rehabilitation Outcomes by Studies

	Study	n	Δ6MWT	ΔSGRQ	ΔBODE
Ries et al[4]	NETT	1218	76 ft	−3.5	–
Puhan et al[15]	CDSR	432	253 ft	−9.88	–
Major et al[6]	Cincinnati veterans study	78	246 ft	−9.5	−1.24
McCarthy et al[7]	CDSR	3822	144 ft	−6.89	–
Doyle et al[a]	GADPRP study	111	259 ft	−6.2	−1.1

Abbreviations: ΔBODE, change in body mass index, airflow obstruction, dyspnea and exercise capacity index; CDSR, Cochrane Database of Systematic Review; Δ6MWT, change in 6-minute walk test; NETT, National Emphysema Treatment Trial; ΔSGRQ, change in St George Respiratory Questionnaire; GADPRP, Grace Anne Dorney Pulmonary Rehabilitation Project of West Virginia.
[a]Study reported in this article.

program. The mean improvement for the 6MWT was 259 ft ($P < .001$). For this measure, 2 persons were unable to complete a post-6MWT; 3 showed no change (within 40 ft of pre-test); 11 had a decrease in distance walked; 95 improved by >40 ft; and 84 (76%) exceeded a minimal important difference of 85 ft.[15]

Table 2 compares the results from our study with results of the same assessments from 4 major studies. The outcomes from our study compare favorably with those published outcomes obtained in PR programs in hospital and academic center settings. Because of differences in patient groups and intervention methods, we did not attempt statistical comparisons with other studies.

EXERCISE MAINTENANCE AFTER GRADUATION

National guidelines stress the importance of continuing regular exercise after completion of a PR program in order for benefits to be maintained.[3] Graduates of GADPRP had the opportunity to return to the training site several times per week for exercise in a familiar environment with staff present. Among the 111 graduates of this program, 40 (36%) have returned for exercise at their program site at least once. Some graduates choose to exercise at home or in other venues. All 3 sites offered times for graduates to continue their exercise program while being monitored by staff.

DISCUSSION

This evaluation was undertaken with 3 main questions for consideration: (1) Is rural office-based PR feasible? (2) What percentages of persons are able to complete a 12-week, 24-session program? (3) Are clinical outcomes equal to those obtained in hospital-based or academic center settings?

This study demonstrated that it is definitely feasible to deliver guideline-consistent PR in rural primary care settings. Furthermore, all 3 sites are strong and growing 30 months after starting. Two more affiliated PR sites have recently opened in FQHCs in 2 additional rural WV counties. This report provides an experience-based measure of typical graduation rates for this type of program, 57% with a range of 48% to 70%. When the added benefits of easier access, post-program continuity of care, and reduced transportation costs are factored in, the case for expanded rural PR services is very strong.

The benefits of PR for quality-of-life, dyspnea levels, and exercise capacity have long been documented.[4-7] More recently, evidence is growing regarding cost savings from PR by reduced hospitalization after exacerbations and overall.[5,16,17] Hopefully, this evidence will convince payers, including state Medicaid programs, to begin paying for PR on a regular basis. An important theme of contemporary chronic disease care is education and activation of patients to do their own self-care. It is hard to imagine a program that better embodies this approach than PR with its hands-on support for regular physical activity and its defined set of education modules.

During this study, we observed important collateral benefits of having respiratory therapists in primary care settings. They improved the frequency and quality of indicated pulmonary function testing. They improved provider skill and confidence in interpreting spirometry and improved application to clinical care. They can support providers in such tasks as oxygen certification and recertification, sleep studies, orders and education for continuous positive airway pressure, asthma action plans, and improved self-care skills for all patients with chronic lung diseases, not just patients who choose PR. These collateral benefits are so great that this project could be viewed more broadly as "bringing respiratory therapy services to primary care" rather than limited to pulmonary rehabilitation.

This study has several limitations. Persons with all types of chronic lung disease were included in this study, which limits comparison to studies of COPD only. Data regarding benefits to persons who partially completed the program were not available. One site had knowledge test and NIF results that could not be included because of faulty measurement techniques. Finally, a formal evaluation of patient satisfaction was not carried out at all sites.

CONCLUSIONS

A guideline-based pulmonary rehabilitation program can be successfully conducted in rural primary care settings with outcomes similar to those reported from large hospitals and referral centers. Adding respiratory therapists to the health care team has collateral benefits including improved frequency and quality of indicated pulmonary function testing, improved knowledge and use of guidelines for chronic lung diseases, and improved patient education for chronic lung diseases.

ACKNOWLEDGMENTS

The authors acknowledge the contributions to this study by the following persons: Len Picha, William Carte, Amanda Jones, Susie Criss, Craig Robinson, Amber Crist, and Philip Galapon. Research support for this study was provided by grants from the West Virginia Clinical and Translational Sciences Institute (National Institute of General Medical Sciences, U54GM104942), the Claude Worthington Benedum Foundation, and the Dorney-Koppel Foundation. This study was conducted under the auspices of the West Virginia Practice Based Research Network.

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