Future Considerations and Areas for Innovation for Pulmonary Rehabilitation in Chronic Obstructive Lung Disease Patients

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Abstract

Keywords

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Chronic obstructive pulmonary disease (COPD) is a common, costly, and morbid disease primarily managed with combinations of inhaled medications.¹ COPD is usually characterized by a slow, inexorable decline in lung function and quality of life that may be mitigated but not cured. The disease course is frequently punctuated with exacerbations and worsening of respiratory symptoms usually consisting of breathlessness, cough, and sputum production. These exacerbations may precipitate decrements in lung function and functional status and are the major cause of health care encounters and costs associated with COPD. While novel bronchodilators, anti-inflammatory agents, and biologics^{2,3} may reduce the frequency and severity of exacerbations, there has been a lack of innovation in the preservation of functional status and quality of life for individuals with COPD. Although dyspnea and poor health-related quality of life (HRQoL) are common in COPD, therapeutic trials commonly underevaluate these measures that are critical to patient wellbeing.^{4,5} Among COPD treatments, pulmonary rehabilitation (PR) is a treatment that promotes salubrious improvements in independence, functional status, and HRQoL. As defined by the American Thoracic Society and European Respiratory Society, PR is a "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

Pulmonary rehabilitation is an effective therapy that improves <u>day-to-day</u> symptoms and quality of life in patients with chronic obstructive pulmonary disease. In this review, we look at the role of virtual programs, implementation of artificial intelligence, emerging areas of improvement within the educational components of programs, and the benefit of advanced practice providers in directorship roles.

> 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." Progress in PR has been incremental at best and innovation is clearly needed to improve how PR is delivered, increasing patient access and ensuring that PR benefits are enduring. In this review, we review novel models for PR delivery, the development of new and innovative PR practices to enhance and improve its efficacy and durability, and the future of PR.

Telehealth and Pulmonary Rehabilitation

Originally, PR was delivered in person with individual and group sessions involving both education and exercise, but these PR delivery paradigms changed dramatically during the coronavirus disease 2019 (COVID-19) pandemic and the subsequent expansion and acceptance of telemedicine.⁶ A systemic review of Tele-PR demonstrated, that although the PR delivery protocols were heterogeneous and did not adhere completely to PR guidelines, Tele-PR improved functional exercise capacity, quality of life, anxiety, and depression, and reduced the impact of COPD on personal life.⁶ A newly published study of Home-based/Tele-PR covering five Veterans Affairs (VA) medical centers

Issue Theme Advances in COPD; Guest Editors: Robert Burkes, MD, MSCR, and Christina MacRosty, DO © 2024. Thieme. All rights reserved. Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA DOI https://doi.org/ 10.1055/s-0044-1791825. ISSN 1069-3424. demonstrated significant improvements in dyspnea, exercise capacity, self-reported steps per day, depression, nutrition habits, and quality of life demonstrating the safety and effectiveness in closing the access gaps in PR.⁷ Led by the University of Alabama at Birmingham,⁸ a multicenter, prospective, clinical trial at academic and Veterans' Administration hospital sites is ongoing to determine the effectiveness of home-based PR compared with standard of care. Homebased PR is an important intervention, that increases access to program resources for underserved rural, infirm, and/or socioeconomically disadvantaged populations.^{9,10} Televisits can be conducted one-to-one with a PR provider or can be performed in a group setting. This flexibility maximizes PR personnel work person-hours and geographically and temporally expands the ability of a limited number of PR providers to address the overwhelming need for cardiopulmonary rehabilitative services among the aging population. To support the utility of home-based, virtual PR, foundational studies suggest that virtual PR is at least non-inferior to inperson programming.¹¹ We are hopeful that the mounting evidence supporting the implementation of virtual PR will be borne out in future hospital administration and insurance payment policies. Currently, those who can provide telerehab services are limited. However, as of this writing, H. R.7623: Telehealth Modernization Act of 2024 and S.3967: Telehealth Modernization Act are before the 118th Congress to permanently extend the authorization of telehealth services through Medicare that was previously only available during the 2020 pandemic. This would allow providers to decrease access gaps across the United States thereby increasing utilization and the ability to cultivate research on this mode of delivery of PR services.

We do foresee challenges arising in implementation due to the technological requirements and an ostensible lack of "buyin" from administrators and policymakers, specifically in the United States, due to the concept of "high-value care" being conflated with "highly profitable care" by these individuals. Future studies will need to analyze the effect of Tele-PR on COPD health care costs to address these fiscal concerns. At any rate, strong telehealth PR programs will prove to be an immense benefit to those patients with limited access to care.

Artificial Intelligence in Pulmonary Rehabilitation

The rise of smart mobile phones and application (app)-based health care programming has opened a new avenue for innovation in PR through app-based, artificial intelligence (AI) programs. While cell phone apps represent a new but growing use of AI, individualized, self-directed PR programs directed by machine learning algorithms are likely to be a very userfriendly means to deliver Tele-PR that obviates the need for multiple times per week travel to a PR center. A meta-analysis of nine studies showed that app-directed home PR programs produced significant improvements in the COPD Assessment Test compared with no AI-assisted PR.¹² Using accelerometry data, the largest of these studies¹³ demonstrated that patients in app-based PR were able to progress their exercise therapy more rapidly over a 12-week period. We believe another benefit of this approach is that having <u>continued availability</u> of these PR apps will allow for maintenance upon completion of PR. Indeed, one needs only to look at the wide swathe of apps offered to assist in automated coaching and program development for high-level bodybuilders to see that there is a future in semiautomated exercise programs to drive the incremental progression and maintenance necessary for clinical improvement and sustainment in individuals with COPD.

A critical caveat in this very exciting frontier of marrying technology with exercise programs is the disentanglement of the zeal for new technical innovations in machine learning and the limitations of these techniques. Even proponents of the use of machine learning in airway disease care note a knowledge gap between data scientists and providers.¹⁴ Largely, AI's imminent contribution to the field of COPD will likely be in diagnosis with potential benefit in prognostication as well as, potentially, phenotyping.¹⁵ There is potential for AI in PR, however, patient performance-directed acceleration of PR programming seems an ostensible future direction, as does the automated identification of functional status decline after discharge from PR and individualized personal education. PR exercise is an individualized exercise program traditionally delivered in a group format, a growing opinion suggests that PR benefits from further personalization.¹⁶ Whether it be directing exercise or providing further situational, individualized education, or other putative benefits, integrating AI may prove to be beneficial in PR.

Education during Pulmonary Rehabilitation

Although exercise to improve strength and conditioning is often the primary focus of PR, education and teaching patients self-management skills are critical elements to a successful and effective PR program. Interestingly, a trial randomizing PR participants to education only demonstrated that this group did not experience any benefits in breathlessness or exercise capacity.^{17–19} This study suggests that, although important, education and self-management training are not beneficial without exercise training. Additionally, studies comparing PR with exercise training alone with exercise and education have not shown significant differences in various clinical outcomes. Self-management interventions do improve HRQoL and reduce COPD-related hospitalizations.^{20,21} Further study is required to define effective PR education strategies and their implementation.

An important component in increasing the effectiveness of PR education may be the timing of this education.^{22,23} The method of education delivery is not standardized among programs and may include printed or electronic reference materials, instructor-led classes, and even app-based content. Along with providing impactful information, the reception of that information may be negatively impacted for some given the significant relationship between COPD and cognitive impairment. It stands to reason therefore to go beyond the norm in providing information included in a pulmonary rehab curriculum most effectively. Exercise is

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generally recognized as having a beneficial effect on memory and cognitive function. Evidence suggests that delivering PR education during an exercise session or in close proximity may help to maximize retention of this information.

The topics covered during PR are not well-standardized and may vary widely between programs. A qualitative methods study using focus groups of patients and providers identified six key educational topics: disease education, management of breathlessness, management of an exacerbation, medications, psychosocial support, and welfare and benefits systems.²⁴ Other key areas that are often included in PR education include advanced care planning, nutrition, management of anxiety, depression, social isolation, maintaining employment with COPD, energy conservation, coping and adaptive skills for everyday activities, intimacy, and smoking cessation.

Another key area for PR education is the training and experience of the educator. PR education may consist of didactic individual or group sessions. Some have suggested that training in motivational interviewing, health coaching, or other behavioral change techniques may be important in achieving durable improvements in PR patients' knowledge and behavior.^{25,26}

In their study, Blackstock and colleagues have identified these areas for further investigation of PR education: (1) outcome assessment for the educational component; (2) screening patients for conditions that will impede the learning process (anxiety, depression, cognitive deficits, and health literacy issues); (3) tailoring content and optimizing the delivery of the educational component; and (4) training PR professionals in their roles as educators.

Marijuana, Burn Pit, Vaping, and Pulmonary Rehabilitation

PR providers often see a patient two or three times weekly and are able to develop a greater rapport and knowledge about the individual than any other member of a COPD patient's care team. In doing so, they can make longitudinal assessments of patients' disease and can intervene during the often-long interludes between patient visits with their pulmonary or general medicine providers. As such, it is of the utmost importance for PR providers to be aware of emerging recreational agents that are toxic to the lungs. With the growing legality of marijuana (MJ) use in the United States and worldwide, there is an importance to impart MJ cessation in PR. Now that MJ use is widely legal and more socially accepted, PR providers need to be aware of specific aspects of MJ cessation. First, much like nicotine withdrawal, symptoms associated with acute MJ cessation occur rapidly after the last dose and are very common. Withdrawal symptoms include insomnia, irritability, decreased appetite, unsteadiness, and occasionally sweating and chills.^{27,28} PR patients who are seeking to guit should be made aware of these symptoms. The rationale for quitting is illustrated by an extensive and thorough review of lung toxicity associated with MJ in this issue. Unfortunately, behavioral intervention therapies have shown only tempered albeit positive

results.²⁹ The humorously named "Quit the Shit" program³⁰ shows that, while behavioral intervention improved cessation, the participant follow-through in this clinical trial was suboptimal. Granted, the bulk of these interventions took place during a time when MJ use was widely illegal. It is likely that MJ cessation approaches are fraught with similar barriers to tobacco cessation. Cessation approaches may also be confounded by MJ's association with counterculture and/or "lifestyle" status. Conversely, hypermoralization (especially in the United States) of the ills of MJ use may lead users to avoid seeking assistance in cessation due to avoidance of providers and settings brandishing a judgmental nature and shame.

Concomitant use of tobacco and MJ may make cessation attempts even more difficult.³¹ However, in the same study, nearly half of MJ users who made calls to state-funded tobacco quit helplines stated that they wished to quit MJ as well. The PR provider, with longitudinal follow-up and a strong partnership with participants, may be the best suited to address MJ cessation for patients' health benefits. It is imperative to incorporate MJ cessation into the PR education process in a nonjudgmental and evidence-based approach to improve patients' health and well-being.

Similarly, the rates of e-cigarette use are high-up to 7% of the U.S. population.³² Like MJ and combustible cigarettes, there is a necessity to incorporate educational components that address the use of e-cigarettes into PR. With observational studies clearly showing a strong association between e-cigarette use and the development of small airway disease in never-cigarette smokers,³³ there is also a need to incorporate e-cigarette cessation approaches into PR educational programs. It must, however, be noted there is a seemingly paradoxical body of evidence that suggests that, as a form of nicotine replacement, e-cigarettes may be effective in aiding quitting combustible tobacco products.^{34–37} To maintain equipoise with these seemingly contradictory bodies of evidence, the PR provider should review the evidence directly with a program participant to formulate a clear quit approach, address concerns rapidly after they arise, and follow through on recommendations and promises. We believe that the optimal approach for any COPD patient is to limit all inhaled toxins and that the frequency of contact between the PR provider and COPD patient is the most ideal interaction to achieve this goal.

Another concerning cause of occupational small airway disease is burn pit exposure. Burn pit exposure occurs more commonly in Veterans than in the general population. PR is a critical aspect of the care for Veterans with COPD and improves metrics of respiratory health while reducing health care utilization and cost.³⁸ Exposure to the collection of dioxins, polyaromatic hydrocarbons, and high concentrations of particulate matter in burn pits is either a major risk factor for or the cause of airway disease.³⁹ However, due to the difficulty of forming an etiologic relationship between burn pits and airway disease, the mechanisms by which burn pit exposure causes airway obstruction remain an area in need of further investigation.⁴⁰ As the Veteran population is already overburdened by COPD⁴¹ compared with the general

population, VA PR providers should be vigilant in eliciting a history of prior burn pit exposure in Veterans with airway disease. We foresee multiple consequences from the recognition of burn pits as a cause of lung disease. First, those exposed to burn pits may represent a significant proportion of younger PR participants and, as such, may have diseaserelated life stressors that are different from an elderly population. Also, it may be worthwhile to increase the intensity of approaches to the cessation of other potential lung toxic exposures such as MJ or other recreational inhalants in this younger population.

From a larger perspective, this section also illustrates the importance of PR interventions beyond progressive exercise. PR represents an all-encompassing environment for promoting health in those with COPD and there will continue to be opportunities to innovate the educational offerings of PR to best suit an ever-evolving patient population with lung disorders.

The Future of Physical Therapists, Exercise Physiologists, and Kinesiologists as Advanced Practice Providers to Meet the Growing Demands for Pulmonary Rehabilitation

Recently, especially in the post-COVID-19 era, there has been an ever-growing demand and need for expanded PR programs.^{42,43} While we have discussed virtual and self-directed options for those in classically underserved and underresourced areas, we would argue that programmatic expansions are also necessary for the delivery of quality PR. PR is far less common in rural areas than in urban centers.⁴⁴ Small studies have suggested the effectiveness of nurse-led PR programs in underserved areas.⁴⁵ We foresee the role of those who provide the session-to-session interventions in leveraging these medical professionals to establish PR programs primarily in under-resourced settings. The role of the pulmonologist in PR is largely to serve as a contact for medical emergencies, act as a liaison with referring providers, and for billing purposes. Further, unless the pulmonologist has a background in exercise science, his or her knowledge of PR is usually due to interest in the intervention and experience. Frequently, oversight of PR programs may fall outside the scope of practice of busy rural pulmonary physicians, regardless of the provider's level of diagnostic and therapeutic acumen. We suggest that the benefits of PR outweigh the potential limitation of finding a physician to direct a PR program and that physical therapists, exercise physiologists, or kinesiotherapists should be considered for roles directing and managing PR programs. The physical therapists and pulmonologists who authored this review and commentary suggest that requirements and certifications for physical therapists, exercise physiologists, and kinesiotherapists as advanced practice providers be developed to allow PR service expansion into areas where PR is needed. The process of PR is a highly collaborative, team environment, requiring input from a multitude of disciplines to identify candidates, provide progressive exercise

programs, educate participants, and ensure long-lasting and durable effects of PR after discharge. While PR sans pulmonologist oversight may limit the ability to care for specific highrisk lung diseases (i.e., advanced pulmonary hypertension, advanced interstitial lung disease, and pre- and posttransplant patients), employing nonphysician providers with expertise in exercise science to direct programs serving the more common lung diseases, including COPD, is needed. The more access individuals with COPD have to PR, the greater will be the population health benefit.

As patients graduate from PR programs, maintenance programming supervised by these advanced practice providers would be beneficial to the patient and overall health care continuum. Patients can be reluctant to call their general practitioner or pulmonologist to report symptoms for various reasons. The practitioner who sees a patient multiple times weekly over continued months and years may act as a gatekeeper and decrease the risk of significant and costly medical resource utilization including hospital stays from delays in care.⁴⁶

Conclusion

PR is an effective therapy to improve HRQoL and promote independence in COPD. PR program accessibility, especially in rural areas, remains a major limiting factor in COPD management. The expansion of programs and leveraging of emerging technologies are exciting developments that may improve access to PR. With the emergence of new risk factors for the development of airway disease such as toxic exposures to burn pits and previously illicit substances, the burden of obstructive lung disorders persists even as the prevalence of cigarette smoking declines. These emerging causes of lung disease in new populations necessitate continued refinement and innovation of COPD management strategies. PR is a crucial element in the treatment of COPD; however, more research is needed to determine the optimal methods to provide PR in-person, via telemedicine, or hybrid delivery modes; self-management versus directed PR; educational topics and PR provider educational methodology training. PR is an ever-evolving component in the COPD armamentarium and is a potent, yet underutilized tool, to improve the health and well-being of individuals with lung disorders.

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