Chronic Obstructive Pulmonary Disease Education in Pulmonary Rehabilitation

An Official American Thoracic Society/Thoracic Society of Australia and New Zealand/Canadian Thoracic Society/British Thoracic Society Workshop Report

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Abstract

According to the 2013 American Thoracic Society/European Respiratory Society statement on pulmonary rehabilitation (PR), education to promote effective self-management is a cornerstone of this intervention. Despite education's stature within PR, there is currently limited evidence supporting its overall efficacy, and minimal evidence guiding its optimal design and delivery. This workshop was convened to focus on the current state of education in PR for patients with chronic obstructive pulmonary disease, who are the most common people referred to PR. The workshop explored the learning needs and limitations of patients participating in PR, promising design features (from work done outside of PR) that may inform our approach to education, and professional development of PR healthcare educators. Areas identified as needing development include: *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 delivery of the educational component; and *4*) training PR professionals in their roles as educators. By necessity, the workshop conclusions are painted in broad strokes. However, with ongoing interest in improving quality through individualized patient assessment, educational design innovations, and scientific scrutiny comparable to that given to exercise training, the educational component of PR may achieve effective self-management, leading to successful behavior change and enhancement in health.

Keywords: pulmonary rehabilitation; education; COPD; workshop report

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Overview

The American Thoracic Society (ATS) Workshop on Education in Pulmonary Rehabilitation for Individuals with Chronic Obstructive Pulmonary Disease (COPD) was cosponsored by the Thoracic Society of Australia and New Zealand (TSANZ), the Canadian Thoracic Society, and the British Thoracic Society, was funded by the ATS, and was held at the ATS International Conference in San Francisco, on May 18, 2016. The purpose of the workshop was to review the current state of education in pulmonary rehabilitation (PR) and examine the formal educational literature outside of the field to inform future educational design, with a view toward enhancing the effectiveness of this component of PR.

The principal conclusions from review of the literature and the workshop discussions are as follows:

- Educational activities are integral to comprehensive PR, providing a foundational knowledge base for behavior change to enhance and sustain positive outcomes.
- Despite education being considered a foundation of PR, measurements of learning outcomes in this area are typically not performed or even recommended.
- The small number of published studies has not yet demonstrated a significant treatment effect of the educational component beyond the benefits observed with exercise training alone within PR for patients with COPD.
- However, in studies separate from PR, educational activities generally focusing on self-management have demonstrated positive effects on healthcare use and quality of life compared with usual care alone, suggesting health benefits when educational activities are completed.
- The PR literature, to date, does not provide a clear direction for the optimal design of educational activities in PR.
- Effective educational design in PR requires a better understanding of the learners and their needs, and the factors that may influence their learning processes.
- Anxiety, depression, health literacy, and cognitive ability can moderate the learning process, and may need to be identified to optimize outcomes.
- Advances in the educational processes (design and delivery) from outside of PR could be used to inform future educational approaches in this intervention.
- PR professionals need to refine their own skills and knowledge to develop and deliver a meaningful and effective curriculum to their patients.

Introduction

PR is a comprehensive and effective intervention that improves health outcomes in COPD and other chronic respiratory diseases (1–3). Its foundations are exercise and education, with the ultimate goal of patients being able to self-manage effectively (2–4). Although the exercise component has been extensively studied and shown to provide unequivocal benefits (5–10), it has been assumed that the education component is "the right thing to do," and that these efforts result in informed patients who are better able to self-manage their disease. The leading international respiratory societies all recommend nonpharmacological and educational interventions within their management guidelines (2, 3, 11). However, the limited studies to date have been unable to show benefit of education over and above exercise training in PR programs (1, 12, 13), or define the optimal educational models in this setting.

Self-management of a complex chronic disease, such as COPD, usually begins with a strong knowledge base, which can nurture appropriate skills and behaviors that ultimately result in improved self-efficacy. Understanding both what knowledge and skills the patient with COPD need to engage in self-management behavior change, and how healthcare providers (HCPs) can best support their patients in learning, is imperative to supporting the development of individuals who have implemented successful self-management strategies. This learning and development of knowledge about one's health condition is diverse, and can be considered formal, through structured health education programs, such as PR, or informal, through conversations with family, friends, self-directed learning online, or impromptu discussions with an HCP. An HCP's understanding of educational design and learning processes is therefore an integral component in supporting a person with COPD to learn, particularly in formal education, where HCPs design and implement the educational activities.

Learning, with the acquisition of knowledge and skills, is foundational to being able to engage in behavior change and self-management, and PR provides an opportunity to formally engage people with COPD in learning activities. Therefore, the educational activities and learning experiences provided in PR should be based on the best available evidence, and structured to impact positively on the health and well-being of the participant. Therefore, the aim of this workshop was to explore mechanisms and strategies that could be implemented to enhance the effectiveness of education (and, in turn, learning) in PR. The specific objectives of the workshop are detailed in Table 1.

Methodology

The workshop was funded by the ATS, and cosponsored by the TSANZ and the Canadian Thoracic Society. The 15-member workshop committee included a patient representative and experts in the fields of PR and education. The committee was interdisciplinary and international, with participants from the United States,

Table 1. Objectives of the Workshop on Education in Pulmonary Rehabilitation for People with Chronic Obstructive Pulmonary Disease

Objectives
1. Review the historical context and the available literature examining the impact of the educational components of PR programs.
2. Determine the knowledge needs and understand the factors that impact on the learning process of individuals with COPD in the context of PR.
3. Examine design features that may be considered to improve educational processes and outcomes in PR
4. Explore the learning needs and ways to improve the teaching process of healthcare professionals in their role as educators.

Definition of abbreviations: COPD = chronic obstructive pulmonary disease; PR = pulmonary rehabilitation.

Australia, Canada, and Western Europe, including Britain. Participants were selected based on their knowledge of the topic, academic work in the areas of PR and/or education, and experience with PR and/or educational programs. Healthcare disciplines represented included medicine, nursing, physiotherapy, and psychology. Potential conflicts of interest were disclosed and managed in accordance with the policies and procedures of the ATS.

The format of the workshop was presentations followed by group discussion. The presentations were founded on the highest level of evidence in the literature on the topic area, but were not mandated to be systematic reviews completed by the presenter. The patient representative was an integral contributor in these discussions. This document of the workshop proceedings was a collaborative effort of all participants and reflects available scientific evidence, workshop discussion, and clinical expertise of the workshop committee. The four committee chairs (F.C.B., S.C.L., L.N., and R.Z.) collated the presentations and written summaries from committee members, and prepared this Workshop Report. All authors, and representatives from the respective societies, reviewed this report before publication. The intended audiences of this Report are PR professionals as well as other patient educators.

State of Education in PR for Individuals with COPD

The Concepts of Education, Learning, and Self-Management as Applied to PR

Education, learning, and self-management are interdependent processes necessary to attain behavior change and, ultimately, enhanced health (14). Figure 1 depicts this concept.

We acknowledge that this framework is simplified. The process, in actuality, is not solely unidirectional, because changes in health status may necessitate a need for new knowledge and skill acquisition, requiring the patient to complete further education and learning to modify and develop new self-management strategies and behavior change (14).

In PR, education has focused on the acquisition of knowledge and skills necessary to optimize care (15). Traditionally, this educational component of PR has taken the form of providers giving information and advice, with the assumption that this knowledge acquisition would lead to successful self-management and healthy behavior change (15). However, education in PR needs to consider expanding beyond this older definition of learning, to include supporting the *process* of learning, which is beyond simple delivery of information to patients. Education should facilitate the development of skills, values, beliefs, and habits of the learner, and directed toward the ultimate goal of healthy behavior change. Patient-centered education provides the framework and foundation for effective self-management, defined as a process with goals of motivating, engaging, and supporting patients to positively adapt health behaviors and develop skills to better manage their disease (16). Ideally, PR professionals must not only recognize the concepts of education, learning, and self-management, but must be effective in facilitating and supporting these processes for the patient. Based on the conceptual framework that education and learning are foundational for effective self-management, this workshop focused on these processes as applied to PR.

History of Education in PR

PR programs were introduced in the 1960s for patients with COPD (17). Historically, programs consisted of didactic education and modest exercise regimens (i.e., walking in a hallway, arm stretches) facilitated by a physician and nurse in a group setting. PR programs, while still maintaining exercise training and education, have become more formalized, interdisciplinary, and goal directed, with a typical structure of 8- to 12-weeks duration and two to three group meetings per week (2). The amount of time a patient spends in a program is, on average, 32 hours, with 25–50% of this time devoted to formalized group education, depending on program design (18). In addition, there are informal educational opportunities, such as the many invaluable teaching moments occurring patient-to-patient and professional-to-patient.

PR education is typically provided by a variety of healthcare professionals (Table 2), with selection of the educator often simply determined by availability and expertise in the content area (15). The style of teaching is generally didactic, often supported by audiovisual aids and handouts. Although technology (internet, DVDs, podcasts, etc.) has a potential role in this setting, patients with COPD are likely to not be familiar with these modalities for learning. Only 53% of people of 65 years of age in the United States access the internet, and this drops to 35% in the over-75-year-old age group (19). As a sequelae, there has been limited uptake of technology-enhanced learning in PR (15). However, with generational change, the uptake of technology use and online access for learning is likely to increase, and, indeed, already 85% of people completing PR use a mobile phone, and 70% have access to a computer or tablet (20). Opportunities for engaging people with COPD in technology-enhanced learning are growing, and research to evaluate will be necessary.

Educational topics have changed little over time, and, globally, the recommendations across international societies are comparable in terms of topics, activities, and duration (2, 3, 21, 22). The importance of medications, symptom control, relaxation, and energy conservation are still prominent. However, in the past decade, topics on advance directives, early recognition and treatment of exacerbations of COPD, the promotion of physical

Figure 1. The framework for education, learning, and self-management in pulmonary rehabilitation. *Education*: those activities designed and implemented by healthcare providers to facilitate knowledge and skill acquisition. *Learning*: the transformative process that patients undergo in acquiring knowledge and skills. *Self-management*: the application of learning to more effectively manage disease. *Behavior change*: the successful application of self-management strategies. *Enhanced health*: the goal of successful behavior change

Table 2. Health professionals involved in facilitating educational activities in pulmonary rehabilitation

Physician/pulmonologist	Respiratory therapist
Nurse	Speech Therapist
Physiotherapist/physical therapist	Exercise physiologist
Dietician/nutritionist	Occupational therapist
Psychologist/social worker	Pharmacist
Physician's assistants	Kinesiotherapists

activity, and long-term adherence with regular exercise have been added (15). Although patients have indicated a desire for education on advance directives (23, 24), the inclusion of most content areas appears to have been determined by HCPs (15, 18). To date, no literature has identified essential or desirable topics for inclusion, and the list of possible topics is diverse, as was determined by Stoilkova and colleagues in 2013 (15) in their most recent systematic review of educational design for COPD. Global practice of education in PR appears to align with societal recommendations based on expert opinion, with over 90% of programs in Europe, North America, and Australia offering educational activities (18, 25, 26). Benchmarking of programs globally for education is a challenge, as learning is contextual and situational (27–30); nonetheless, the key features appear comparable, limiting the ability to draw conclusions for best practice (18).

Measurement of education and learning includes two components: the learning and achievement of the patient in acquiring knowledge and skill; and the quality of the learning experience. Although over 90% of programs deem education to be important, most do not measure outcomes of the educational processes (18). Despite the availability of several validated questionnaires, such as the Lung Information Needs Questionnaire or the Bristol COPD Knowledge Questionnaire (Table 3), most programs only measure exercise-specific outcomes, symptom burden, and/or quality of life (18). Furthermore, there is no reference to assessment of learning needs to determine group demographics for selection of educational activities and focus areas, or to obtaining feedback from patients on

Table 3. Patient knowledge questionnaires in chronic obstructive pulmonary disease

Questionnaire	Description	Scoring	Psychometric Properties	Time to Complete (*Min*)
BCKQ (31)	Assesses patient's knowledge about topics related to COPD (e.g., symptoms, exercise, preventative measures, inhaled steroids).	65 items. Scoring of true +1 and 0 false. Scoring based on percentage of items answered correctly.	Test retest $r = 0.71$ Cronbach's $\alpha = 0.73$	15–20
COPD-Q (32)	Assesses knowledge of COPD.	13 items, scores range from 0 to 13 based on correct responses; higher scores indicate greater correct responses.	Test retest ICC = 0.90	Not available
LINQ (33)	Assesses patients' need for information about their COPD to guide clinical encounters. Six domains include: disease knowledge; medicines; self-management; smoking; exercise; and diet.	17 items. Scoring based on summing the items from each domain. Scores range from 0–25 with higher scores indicating higher need for information.	Cronbach's $\alpha = 0.72$ Test retest Each domain $r = 0.66$–0.98	6
UCOPD (34)	Assesses understanding of COPD, managing symptoms of COPD and accessing help and support (part A, 18 items) and satisfaction with education program (part B, 6 items).	24 items. Scoring calculated on percentage for parts A & B with scores ranging from 0 to 100% (greater understanding, confidence etc.).	Total score $r = 0.89$ Cronbach's $\alpha = 0.62$ Test retest Section A ICC range = 0.87–0.96 Section B, Wilcoxon signed rank test (no difference) $P > 0.05$ Cronbach's α range = 0.78–0.95	7

Definition of abbreviations: BCKQ = Bristol COPD Knowledge Questionnaire; COPD = chronic obstructive pulmonary disease; COPD-Q = COPD Knowledge Questionnaire; ICC = intraclass correlation coefficient; LINQ = Lung Information Needs Questionnaire; UCOPD = Understanding COPD questionnaire.

content being presented. Underscoring this omission, recent statements and guidelines on PR do not list educational achievement as one of the essential outcomes that should be measured (2, 4). This lack of data related to measuring educational outcomes may have led to our current state of "limbo" regarding education in PR programs.

Available Literature Evaluating Education in PR

To date, most of the research in PR has focused on muscle physiology and the effects of exercise training (5–10). Evaluating the educational processes has not received the same degree of attention within the context of PR, with limited research concerning the educational needs of patients with COPD. To illustrate this, in the recent ATS/European Respiratory Society document on PR, 760 citations were noted, but fewer than 20 were related to education (2).

Health education is anticipated to impact five possible patient domains: *1*) knowledge; *2*) perception of benefit; *3*) health beliefs; *4*) health behaviors; and *5*) health outcomes. Two studies have examined the impact of education on knowledge acquisition, and demonstrated that education in PR does improve health knowledge (31, 35). Relationships between knowledge and any of the other aforementioned domains have not yet been examined for patients with COPD, and therefore the impact of this improved knowledge after PR on health is not yet understood. Patient perceptions of the lived experience of education in PR have demonstrated a positive impact. A systematic review of five qualitative papers concludes that education in PR is considered by patients to be an important component (36). The reviewers further conclude that patients experience a strong sense of learning, allowing them to acquire skills, knowledge, and a new way of life, as patients assume different behaviors and routine adjustment through the education sessions (36). With respect to health beliefs and health behaviors, the impact of education in PR has not yet been evaluated.

To date, the most significant body of research evaluating the impact of education in PR has examined health outcomes. Two trials have compared education plus exercise training to exercise training alone in PR (12, 13). Both exercise only and exercise plus education led to significant improvements in health outcomes, including health-related quality of life, healthcare use and hospital admission rates, symptoms, exercise capacity, functional capacity, lung function, and anxiety and depression, with no significant difference between the groups. The only finding that was significant was that a greater proportion of participants who completed the PR program occurred in the group that completed the education (12). The most recent *Cochrane Review* evaluating PR (1) supports these findings with a subanalysis evaluating the impact of more comprehensive models of PR to exercise training alone. This review demonstrated no significant effect on quality of life with the addition of education in the comprehensive designs (1). Furthermore, the clinical practice guidelines for PR published by the TSANZ also supports these findings, suggesting that there is moderate to low-level evidence based on only four trials for structured education programs in PR (21).

Disease-specific education and self-management programs in COPD, outside of the PR setting, have each been compared with usual care in several systematic reviews (37–41). The results show a reduction in healthcare utilization and improved quality of life. Subanalyses to identify effective program components were, however, limited by heterogeneity of study interventions and lack of detailed intervention descriptions. Reviews were therefore unable to identify a specific educational model that improved health outcomes, but noted greater impact on health outcomes from self-management–focused educational design than from a didactic approach.

The above discussion about the state of education in PR highlights the need for better understanding of the design features and effects of education in terms of learning and impact on adherence with PR. The literature also demonstrates that not all potential outcomes have yet been evaluated, including change in behavior, beliefs, and adverse outcomes. To design innovative education models and evaluate the most appropriate outcomes, we need to better understand the learners who are participating in PR.

Learners with COPD

PR provides an excellent platform for acquisition of foundational knowledge and skills to support effective management of COPD. Patients enrolled in PR programs have exposure to the PR team for large blocks of time, providing opportunities to ask questions of staff, interact with others with COPD, and exercise in a supervised environment. Furthermore, the PR staff has time to observe activities, such as exercise pattern and inhaler use, and to learn about patient concerns, identifying learning needs and supporting patients to develop their knowledge and skills.

Ideally, this educational process in PR should follow the traditional adult learning principle of rooting the material within the individual's meaningful context through real-time repetition and practice, as well as self-appraisal and personal reflection. Specifically, when individuals understand what they are learning and make linkages to things they already know, learning, retention, and retrieval are much easier (42). This linking between new knowledge and what an individual already knows does not always occur automatically, and may need to be knowingly made by the individual through active construction of associations (43). In this way, PR education and the learning that occurs during that process must both be active and effortful. In addition, if the individual with COPD learns things in the same order, and in context of when he/she might use the knowledge, the learning is more effective (44). For example, when learning the process of self-administering inhaled medications, it is best to learn the steps in order (skills) and practice taking the medication in a home environment (context). This encodes the information efficiently for recall and use at a later date. The contextualization of learning is not limited to physical location of recall of information and/or skills, but also includes cultural contexts related to health beliefs, religious beliefs, lifestyle focuses, and ethnoculture. Therefore, facilitation of learning occurs when it is meaningful for the patient, supported by concrete, constructive feedback (45, 46), and with strong encouragement of the individual to take an active role in his/her own learning (47).

The Effects of Psychological Factors on Learning

Depression and anxiety symptoms are common in COPD. Their reported prevalence varies widely, possibly due, in part, to differences in the instruments used in their measurement (48). Reasonable estimates of depression and anxiety in COPD are 40% and 36%, respectively (49); however, they are often undiagnosed and untreated

(50). In addition, patients with COPD experience up to 10 times the rate of panic disorder compared with the general population (51).

Depression and anxiety may impact learning in the rehabilitation setting. Depression is associated with memory deficits (52), and co-occurring depression and anxiety are associated with verbal memory impairment (53). In addition, depression predicts noncompletion of PR (54), and a threefold increase in nonadherence to medical treatment regimens (55). Anxiety has been demonstrated to cause individuals to selectively allocate more attention to "threat-related" stimuli and less to the task at hand, negatively affecting learning and performance (56). In contrast, anxiety about task performance may also serve a motivational function; individuals may allocate additional processing resources (e.g., effort) and initiate processing activities (e.g., strategies) aimed at improving performance. This is done by anxious individuals to avoid aversive consequences of poor performance, and to try to escape from the state of apprehension associated with worrisome thoughts (56). In light of these findings, brief psychological screening tools (Table 4) (57–63) can offer PR professionals important information in identifying these impediments to memory and motivation, and through their treatment, *potential* ways of enhancing learning and adherence to medical management. Positive screens will guide recommendations for further evaluation and intervention by a qualified mental health professional, either within the program or in the community. Depression screens may contain items assessing suicidal ideation, and patient responses to these questions require immediate review and an appropriate intervention from a qualified professional to ensure patient safety. Future research evaluating the impact of mental well-being on learning is now required to understand the importance of anxiety and depression on health outcomes and positive health behavior change.

The Effects of Cognitive Impairment on Learning

Individuals with COPD are at increased risk of structural abnormalities, leading to cognitive impairment. Decreased hippocampal volume (64), increased deep or infratentorial microbleeds (65), and white matter lesions (66) are more frequent in COPD. These structural changes can lead to functional impairments, including deficits in reaction time, executive function, prospective memory, visuospatial memory, verbal memory, and numeric short-term memory (67–69). Compounding these changes, other factors increase the likelihood of cognitive impairment in patients with COPD, including exacerbations, comorbidities, disease severity, and long-term hypoxemia, with exacerbations having the highest risk (70, 71). The latter may be highly significant, as many individuals are only referred to PR after hospitalization for exacerbation.

Given the current state of knowledge on cognitive impairment associated with COPD, individuals should be considered for screening cognitive function upon entry to PR. Screening will allow the HCP to understand the individual enrolling in PR in order to tailor educational activities to their cognitive status. Furthermore, a referral for a comprehensive neuropsychological evaluation can be facilitated when concerns are noted. Several types of screening tests are available (Table 5) (72–83). With respect to a single measure of cognitive function, the Montreal Cognitive Assessment may be the preferred instrument to assess cognitive dysfunction in COPD (84). However, administration of the Mini Mental State Exam in combination with another screening instrument may improve detection of cognitive dysfunction, and therefore a combination of tools may be more appropriate when cognitive impairment is observed (85); for example, combining an overall measure of cognitive ability, such as the Mini Mental State Exam, with the Clock-Drawing Test, an assessment of executive functioning.

To address the negative effects of cognitive impairment on learning, one must either treat the cognitive impairment directly or adapt the educational intervention. There is limited evidence that formal cognitive training improves cognitive impairment in COPD (86). In the original nocturnal oxygen therapy trial, oxygen use in long-term hypoxemia led to improvement of cognitive function (70). However, the evidence is mixed in relation to the impact of exercise and/or PR on cognitive impairment (86, 87). Aerobic exercise alone and in combination with strength training has been demonstrated to improve cognitive functioning and, in particular, executive functioning (planning, task coordination, and working memory) in older adults (88, 89). Where adaption of the education intervention is needed, screening can provide an appraisal of the presence and nature of cognitive impairments, so that the education can be tailored, as well as reinforced and supported by significant others involved in caring for the individual. However, research exploring what adaptions lead to greater learning, and ultimately health behavior change, is now needed to develop intervention strategies to support learning in PR.

The Effects of Health Literacy on Learning

Health literacy is the degree to which individuals have the capacity to obtain, process, and understand basic health information and the healthcare services required to make appropriate health decisions (90). Low levels of health literacy are common in COPD, and are associated with limited disease knowledge, suboptimal adherence to medical regimens, poor symptom management, and diminished quality of life (91–95). Health literacy is influenced by socioeconomic factors, educational factors, and learning difficulties (95). Additional factors that contribute to poor health literacy include impaired communication between healthcare professionals and patients (96–98) and cognitive impairment (99). A reduced belief in the chronicity of their illness and a greater negative emotional representation of their disease is present in those patients with COPD with poor health literacy, and is linked to impaired self-management behavior (91). Lower health literacy also influences motivation, with less information seeking and decreased self-efficacy noted for health-related actions (97, 100).

Baseline literacy levels are predictors of participation in adult education: the higher the levels, the greater the likelihood of participation and engagement (101). Those engaged in learning are also more likely to develop critical thinking and decision-making abilities (101). As a result of developing such skills, improvements in health have been noted, with more knowledgeable individuals three times more likely to incorporate preventative behaviors and more likely to believe they are in control of their health (102).

To enhance an individual's engagement with education, greater awareness by PR professionals of the varying health literacy levels in patients with COPD is important (103, 104). Although it is likely that the

Table 4. Depression and anxiety screening tools

Tool	Description	Scoring	Psychometric Properties	Time to Complete (*Min*)
PHQ-9* (57)	*Depression screener* • 9 Items • Suicide Item (yes)†	0–4 = none to minimal depression 5–9 = mild depression 10–14 = moderate depression 15–19 = moderately severe depression 20–27 = severe depression	Cut score of 10 or greater/equal sensitivity and specificity of 88% for MDD Scores of ⩾8 diagnostic of depression in chronic conditions	<5
BDI-II* (59)	*Depression screener* • 21 items • Suicide item (yes)†	0–13 = minimal depression 14–19 = mild depression 20–28 = moderate depression 29–63 = severe depression	Internal consistency: 0.9 Concurrent validity: 0.66–0.86	5–10
GAD-7 (63)	*Anxiety screener* • 7 items	0–4 = minimal anxiety 5–9 = mild anxiety 10–14 = moderate anxiety 15–21 = severe anxiety	Construct validity: 0.72	<5
BAI (58)	*Anxiety screener* • 21 items	0–9 = normal 10–18 = mild–moderate anxiety 19–29 = moderate to severe anxiety 30–63 = severe anxiety	Internal consistency: 0.92 Construct validity: 0.47–0.81 (136) Factor structure of BAI was distinct from BDI Correlation of BAI and BDI scores: 0.48	5–10
HADS* (61)	*Depression and anxiety screener* • 14 items (7 depression; 7 anxiety) • Suicide item (No)	Total score = 0–42 Depression score = 0–21 Anxiety score = 0–21 0–7 = not significant 8–10 = mild depression/anxiety 11–15 = moderate depression/anxiety 16–21 = severe depression/anxiety	HADS-A: Cronbach's α = 0.78–0.93 HADS-D: Cronbach's α = 0.82–0.90	5–10
Psychosocial Factor Risk Survey (62)	*Depression and anxiety screener* • 70 items • 4 subscales-depression, anxiety, social isolation, emotional guardedness	T scores 30–53 = not significant 54–59 = mild depression/anxiety 60–65 = moderate depression/anxiety 66–80 = severe depression/anxiety	Depression subscale Cronbach's α = 0.90 Anxiety subscale Cronbach's α = 0.87 Depression and Anxiety Subscales loaded on to general distress component Correlation of Depression Subscale and BDI II: 0.806 Correlation of Anxiety Subscale and BAI: 0.62	12–15

Definition of abbreviation: BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory II; GAD-7 = Generalized Anxiety Disorder Scale; HADS = Hospital Anxiety and Depression Scale; MDD = major depressive disorder; PHQ-9 = Patient Health Questionnaire.
*Endorsed by National Institutes for Health and Clinical Excellence to evaluate depression and responsiveness to treatment in primary care.
†Endorsement of suicidal ideation requires immediate review and appropriate intervention from a qualified professional to ensure patient safety.

majority of patients have moderate to low levels of health literacy (94), screening an individual's health literacy level may offer further insight into additional resources, which may benefit an individual patient (105–111). A variety of tools are available, each with different psychometric properties and measurement applications (Table 6). Although the REALM (Rapid Estimate of Adult Literacy in Medicine) test and the TOFHLA (Test of Functional Health Literacy in Adults) are commonly used in research to assess health literacy, their multi-item structure, length of time required to administer, or limited availability in a particular language may limit their application in clinical practice (112). Alternative options that are easier to administer in the clinical environment are the NVS (Newest Vital Sign) and the Brief Health Literacy Screening (110, 111). Both tools have identified key questions (confidence in completing forms) that are the strongest predictors of limited or marginal health literacy (113), and their quick administration (maximum of 3 min) supports their ease of clinical use. Tailoring educational resources to adapt to a broad range of health literacy is important. Strategies include: *1*) use of printed resources, which includes pictorial images to reinforce spoken words; *2*) checking patient comprehension; *3*) involvement of family support; *4*) avoidance of medical jargon and professional terms; *5*) use of varying multimedia sources (CD, DVD, audio formats); and *6*) having sufficient numbers of

Table 5. Cognitive functioning screening tools

Tool	Description	Scoring	Psychometric Properties	Time to Complete (*Min*)
CLOX 1 and 2 (73)	Executive Clock-Drawing Task evaluates executive function. It consists of two parts. CLOX 1, the individual is asked to draw a clock (on a blank piece of paper) setting the hands at 1:45. CLOX 2, the administrator draws a clock with hands set at 1:45 for the individual to copy.	Scores on CLOX 1 $<$ 10, and CLOX 2 $<$ 12 represent greater impairment in executive function	Interrater reliability: CLOX 1 $r = 0.94$, $P < 0.001$ CLOX 2 $r = 0.93$, $P < 0.001$ Internal consistency: α 0.82 Construct validity with: EXIT 25 $r = -0.83$ MMSE $r = 0.85$	$<$5
MMSE (74)	General screening test of orientation and short-term memory. 11 domains examining functions such; as registration, attention and calculation, recall, language, ability to follow simple commands visual spatial and orientation.	A possible total score of 30. Recommended high cutoff of $<$27 enhances sensitivity to detection. Mild (19–23 points), moderate (10–18 points), or severe ($\leqslant$9 points) cognitive impairment.	Test retest: $r = >0.75$ (80) Interrater: ICC = 0.69 (81) Internal consistency = α 0.78 (82) Sensitivity and specificity of the MMSE for detecting mild cognitive impairment reported at 18% and 100%, respectively.	5–15
MoCA (72)	General screening test, examining functions similar to the MMSE, but also has executive function features.	A possible total score of 30. Normal (25–30), mild cognitive impairment (18–24), severe cognitive impairment (0–17).	Test retest: $r = 0.92$ Internal consistency $\alpha = 0.83$ Sensitivity and specificity of the MoCA for detecting mild cognitive impairment reported at 90% and 87% respectively.	10
Stroop Test (77)	A psychological test of mental vitality and flexibility. The task takes advantage of our ability to read words more quickly and automatically than we can name colors. A measure of cognitive processing by measuring reaction time. Three cards are used consisting of 100 words, 100 colors, and 100 colored words.	Scores are based on the number of items completed for sections: W, C, CW, and an I score, based on the W, C, and CW scores. T scores less than 40 for each are significant.	Reliability: W = 0.89; C = 0.84, CW = 0.73 (77) Concurrent validity: I scores correlated well with other measures of attention (79).	5
Trail Making Test	A test of visual attention and task switching. Consists of two parts using two different visual conceptual and visuomotor tracking conditions. Part A involves connecting numbers 1–25 in ascending order, testing cognitive processing speed. Part B involves connecting numbers and letters in an alternating and ascending fashion, assessing executive function.	Scoring is based on the number of seconds to complete each part. Trail A $>$ 78 s is deficient, Trail B $>$ 273 s is deficient.	Test retest: Part A = 0.79 Part B = 0.89 (79) Convergent validity with WCST $r = 0.31$ VAST $r = 0.30$ (83)	5–10

Definition of abbreviation: C = color score; CLOX = Executive Clock Drawing Test; CW = color-word score; EXIT = executive cognitive function; I = interference score; ICC = intraclass correlation coefficient; MMSE = Mini Mental State Exam; MoCA = Montreal Cognitive Assessment; VAST = Visual Search and Attention Test; W = word score; WCST = Wisconsin Card Sort Test.

personnel with enough time to facilitate learning (96, 114). Written material should be tested for readability, and pictures should be of adequate size (95, 114).

Ideally, discussion and education in management approaches between the patient and healthcare professional involves careful explanation by the professional with a focus on the need to know and the need to do, with patient understanding checked through the use of teach-back. In teach-back, after initial dialogue and description, patients are asked to repeat (in their own words) what information they need to know and what to do (102, 115). This is an effective means of closing the loop of communication between the healthcare professional and the patient, and is a method of confirming how well the patient has understood a concept. It provides an opportunity to check a patient's understanding and creates, if necessary, an additional teachable moment to reinforce the information. Teach-to-goal is another educational strategy that includes the use of teach-back. In teach-to-goal, the learning goals are first identified and form the focus for the educational material (116). This information: *1*) explains a behavior; *2*) provides background information to understand a recommended behavior; or *3*) promotes an attitude change about the behavior. Educational material provides direct support for the learning goals, with the goals being the focus of questions to determine if a patient has mastered and understood the key information presented. Teach-back confirms understanding of each concept until mastery is attained. Research into the impact of including health literacy screening, including cost–benefit and burden of completion, for educational design in PR is required to determine the role of screening and such educational strategies.

Design Features that May Enhance Learning in PR Programs

The goal of educational design should be to achieve experiential learning that is transformative and ultimately improves outcomes (117–119). Quality educational design consists of: *1*) creating objectives based on learner needs; *2*) formulating a delivery strategy (consisting of content and method of learning); and *3*) assessing learning outcomes. PR has traditionally only emphasized step two, formulating a delivery strategy.

Learning objectives are classified as cognitive (improve knowledge), affective (change attitudes), or psychomotor skills (enhance hands-on performance) (120). A prominent text on curriculum development for medical education recommends creating a table with: *1*) measurable learning objectives; *2*) the educational method(s) to achieve the learning objectives; *3*) the method(s) for maintenance of the objectives; and *4*) required educational resources (120) (*see* exemplar generated by the workshop team educational designers presented in Table 7). Design within PR programs will vary with the learning objective(s) and available educational resources (for example, personnel, time, or equipment resources). Learners, which may include patients and carers, will have different learning styles and attention spans, so the use of multiple modalities is preferred. Delivery method preferences may include group sessions, hands-on demonstrations with visual aids and models, peer-to-peer learning, case-based learning exploring cases that underpin development of understanding and acquisition of knowledge, and the availability of supplemental learning materials that can be reviewed at a separate time (121). This last preference may allow for a "flipped classroom," in which learners are asked to view materials before the educational activity, reserving class time for discussion and questions. The flipped classroom often uses online learning to support this process, making available information and self-assessment quizzes through a website that learners access and complete before class. Activities can be designed such that learners bring the completed task (e.g., completed quiz or written piece of work) to the "class" the next session and discussion focuses on the learning that was completed online, allowing clarification of content and expansion of understanding.

Lectures or "large group didactics" remain most common and efficient based on the number of people involved in the learning activity, but such one-way communication relies on speaker skills, and risks a passive, disengaged audience. Learners' attention drifts off after 15–20 minutes, with learners tending to remember opening remarks and conclusions, but less often the material in the middle. A suggestion is therefore to put any administrative information at the end of the talk and not during the precious initial few minutes. Another established classroom tip includes a "pause procedure" of 2 minutes every 15 minutes (122), during which the learners reflect and discuss with the person next to them. This strategy improves recall (123). Audience response systems are another method of engagement, usually in the form of inserting multiple-choice questions, but free text is also an option. Engagement through this strategy can be achieved using interactive devices, such as clickers, or free online software using cell phones also works well. Audience use of hand signals (i.e., show one to five fingers over one's chest to indicate answers A through E) is a no-cost, low-tech way that still offers some privacy over raising one's hand, and may be more appropriate for individuals with COPD (124). If one is going to use slides, several guides are available to support slide creation that enhances engagement for the learner (125).

Given the multiple factors that may influence learning in PR, measurement of the learning that occurs is crucial. Quizzes and tests after individual education sessions, or at completion of the overall program, are ways of encouraging attention by having some "accountability" at the end—even if these tests are "low stakes" (126, 127). Quizzes may also be completed as a group answer to encourage discussion among peers and decrease potential anxiety related to needing to know the answer. Other methods of assessment may include simulated case scenarios (assessing patient ability to identify a COPD exacerbation or use an inhaler), patient journal reviews, and telephone follow-up. These more in-depth assessment processes and feedback from them may have the additional benefit of stimulating a deeper level of learning and self-reflection as compared with quizzes, and warrant further exploration in educational design for PR. Structured reflection activities using a reflection framework will also support this process and could be evaluated with future research.

Simply measuring a patient's knowledge using a program designed assessment is unlikely to fully reflect the extent of learning in PR, because an effective learning process must include application of that knowledge to life situations and, ultimately lead to behavior change. Therefore, more robust tools should be considered to fully assess effectiveness of the education. For example, the LINQ (Lung Information Needs Questionnaire) reflects patients' perspectives of what they believe they need to learn and how to apply this

Table 6. Commonly used questionnaires measuring health literacy

Questionnaire	Description	Scoring	Psychometric Properties	Time to Complete (*Min*)
NVS	Five scenarios of 21 questions assessing the understanding of text and use of numeracy	Less than four correct answers indicates low literacy.	√ Internal consistency: >0.76 √ Correlation with TOFHLA: 0.88. Sensitivity (score <4): 100%, specificity (score <4): 0.64 (111)	3
BHLS	Set of 3 questions with content based on five domains: navigating the healthcare system, completing medical forms, following medication instructions, interacting with providers and reading appointment slips	Inadequate HL: scores of 0–16 Marginal HL: scores 17–22 Adequate HL: scores 23–36.	Correlation with TOFHLA: Help reading AUC 0.87, Confidence with forms AUC 0.80, Problems learning AUC 0.76 (110)	2
REALM test	Medical word recognition and pronunciation test.	Score 0: Third grade and below; will not be able to read most low-literacy materials; will need repeated oral instructions, materials composed primarily of illustrations, or audio or video tapes. Score 1-3: Fourth to sixth grade; will need low-literacy materials, may not be able to read prescription labels. Score 4–6: Seventh to eighth grade; will struggle with most patient education materials; will not be offended by low-literacy materials. Score 7: High school; will be able to read most patient education materials.	√ Internal consistency: 0.91 (Bass and colleagues, 2003 [134]) √ Correlation of REALM and WRAT: 0.83; correlation of REALM and PIAT-R: 0.97 Correlation of REALM and SORT-R: 0.88 √ Test-retest reliability: 0.99 (107)	3–6
TOFHLA (short and long form)	Numeracy and reading comprehension	**Short form:** Total score ranging from 0 to 36 (correct answers receive a score of 1, incorrect receive a score of 0) Score 0–16: Inadequate functional health literacy (unable to read and interpret health texts) Score 17–22: Marginal functional health literacy (has difficulty reading and interpreting health texts) Score 23–36: Adequate functional health literacy (able to read and interpret most health texts) **Long form:** Total score ranging from 0 to 100 (correct answers receive a score of 1, incorrect receive a score of 0) Score 0–59: Inadequate functional health literacy Score 60–74: Marginal functional health literacy Score 75–100: Adequate functional health literacy	√ Concurrent validity: 0.74–0.84 (94) √ Internal consistency: 0.90–0.97 (109) √ Test-retest reliability: 0.92 (135)	Long form: 22–25 Short form: ⩽7
SAHL	• Comprehension and pronunciation of health-related words • Total of 18 test items.	A correct answer for each test item is determined by both correct pronunciation and accurate association, scoring 1 point for each correct answer. Total points = the SAHL-E score. Score between 0 and 14 indicates low health literacy.	√ Correlation of SAHT and REALM: 0.94, Correlation of SAHL and TOFHLA: 0.68 √ Test-retest reliability: 0.89 (105)	2–3

Definition of abbreviations: AUC = area under curve; BHLS = Brief Health Literacy Screen; HL = health literacy; NVS = Newest Vital Sign; PIAT-R = Peabody Individual Achievement Test–Revised; REALM = Rapid Estimate of Adult Literacy in Medicine; SAHL = Short Assessment of Health Literacy; SORT-R = Slosson Oral Reading Test–Revised; TOFHLA = Test of Functional Health Literacy in Adults; WRAT = Wide Range Achievement Test.

information in real-life settings (33); other examples are outlined in Table 3. More methods of assessing learning may be reflected by patient attendance and participation in education sessions, assessment of their coping skills, changes in health belief and self-confidence, and the ability to apply this knowledge in a specific context. New valid and reliable tools to measure the impact of learning on these outcomes are needed. Furthermore, the above-suggested educational designs need evaluation in the context of PR. Motivation, recall, and experiences of patients with COPD completing PR may not be the same for patients participating in educational interventions for other chronic conditions or those undertaking a university education, from which these ideas have been drawn.

Professional Development of Healthcare Educators

For the delivery of an effective and comprehensive educational curriculum in the context of PR, there should be a focus on a well-trained and motivated interdisciplinary team. The skill set required for prescription and delivery of an exercise training program is not the same skill set needed for design and delivery of education. Similar to patients as learners, the healthcare professional is a learner for the educator role. There is a paucity of guidance for the healthcare professional with respect to the educational component over and above guidance on the potential topics for discussion in PR. In light of this, direction could be taken from the adult education literature (120), with limited guidance specifically for healthcare professional development in patient education for COPD.

The knowledge of the HCP is usually assumed and not directly tested. It has recently been suggested that, in the United States, nurses have very little training in COPD, and develop their knowledge based on the degree of exposure to pulmonary patients rather than any formal educational opportunities (128). In a recent paper examining healthcare professionals' understanding of educating patients for development of self-management skills, most staff interviewed believed that "their professional knowledge alone ensured the skills and competence to support patients with COPD to self-manage" (p. 1,048 in Reference 129). When this was explored further, there was little perception of potential learning needs, except among more junior staff (129). Clearly, the learning needs of staff extend beyond knowledge of the subject matter and extend to an understanding of the learning needs of participants, the learning style of groups, and an appreciation of the complex process that leads to behavior change. Therefore, staff needs to move through similar steps in the learning process: *1*) a self-appraisal of knowledge and skills for teaching; *2*) development of personal learning objectives; *3*) completion of training targeted at meeting those learning objectives; and *4*) assessment of competency for teaching.

A further area of consideration for development of healthcare professions is management of group dynamics to ensure that optimal outcomes are achieved for all participants. Learners need to be motivated and active participants in a well-designed session. Because some individuals can negatively alter group dynamics, it is important that PR professionals are equipped with strategies to deal with these situations. There is a danger for "talkers" to monopolize the discussion, and a concern that "nontalkers" suggests nonlearning. Occasionally, there can be disruptive members of the group, and these require skillful management. These skills may be rehearsed with scenarios and the support of a second facilitator in the group.

With the increasing use of technology, there is an opportunity to consider additional methods by which the educational content may be delivered in PR, either as an alternative, or to enhance the face-to-face educational interactions. There are examples of using technology within the context of conventional PR programs (130) to overcome geographical challenges. Other options might include the use of DVDs (131), social media, or the internet. The HCP should consider exploring the plethora of tertiary education literature on technology-enhanced learning designs to learn about these opportunities that may support learning, both face-to-face and from a distance (120, 132, 133).

Future Directions

The ultimate goal of advancing the science of education and learning in individuals with COPD, and specifically the proper implementation of this science in the PR setting, is to foster behavior changes that enhance health. As is clear from this Workshop Report, the science behind the educational component of PR is still in its early developmental stage. Optimal implementation of the PR educational component will depend on continued scientific inquiry. Research that directly compares different models of education within the same randomized, controlled trial, not between two different trials, and that uses measures that assess learning outcomes, mortality rates, and adverse events, are needed. However, as our patients need us now, published evidence and expert opinion are available to help us educate them in the meantime. Looking at potential factors impacting learning by patients, the committee proposed several areas to explore and work toward advancing the field:

- Individualizing patient assessment, focusing on factors that may moderate learning, including prior knowledge, cognitive function, psychological state, and health literacy. Assessment would include application of existing, or newly developed, screening tools in these areas. Research is needed to optimize targeted screening.
- Analogous to measuring exercise capacity to assess exercise training, assessing learning outcomes, not solely health outcomes, is necessary to optimize and refine the educational component of PR. This would include using existing measures or creating new, valid, feasible, longitudinal measures, and then studying the relationship of this learning to clinical outcomes, with publication of results to guide future educational design.
- Designing education based on the cognitive, psychological literacy levels and learning needs of the individual patient. This includes research to understand what features may suit differing people, enabling educational activities to be targeted to the individual, focusing on patient feedback and perception.
- Incorporating educational design best practices currently available from fields outside of PR, as outlined in this Report, until further study in our unique PR population allows refinement. These may include pedagogical approaches, technology-enabled learning, and assessment of attainment of learning for patients both before and after completion of the program.
- Exploring the potential role of education to promote adherence to PR, including

Table 7. Exemplar of curriculum design for pulmonary rehabilitation: inhaled respiratory medication use

	Cognitive (Knowledge)	Affective (Attitudinal)	Psychomotor (Skill or Performance)
Specific measurable objectives	1. Recall the primary medications used in the management of COPD 2. Understand the process by which the medications affect the lungs to improve symptoms	1. Understand the necessity for adherence with medication routines 2. Recall the adverse events associated with lack of adherence with medications 3. Adhere with personal medication routine for at least 1 week	1. Accurately self-administer X medication using Y inhaler device
Educational method to achieve learning objective	1. Lecture to the group giving overview 2. Small group discussion among peers, completing interactive activity on how the lungs work and different drugs influence their function.	1. Development of medication routines, that are individually tailored and structured by the patient with support from the PR professional 2. Peer discussion on the issues when medication routines are not followed.	1. Demonstration of technique for inhaler use—live during the PR class, and available as an online video for viewing at home 2. Repetitive practice with peer observation and review 3. Patient films self, taking inhaler and uploads to YouTube for peers or PR professional to review and provide feedback. 4. Final review by PR professional to confirm technique correct—if incorrect, repetitive practice with peer feedback, then repeat assessment by PR professional until correct technique
Educational method to prevent decay	1. Quiz on the different respiratory medications and modes of delivery 2. Quiz on the process by which medications influence the lungs	1. Review of medication routine 2. Diary of medication use for 1 week, with peer discussion on when medication routines are not followed—what are the challenges and how can you overcome?	1. Review of inhaler technique weekly for 4 weeks to ensure remains correct—practice in front of peers, then assessment by PR professional.
Resources required	1. Microsoft PowerPoint 2. Data projector and lap top 3. Activity sheet for completion during the class—includes discussion activities that foster development of understanding not just memorizing.	1. Diary to document medication routine. 2. Diary to document medication adherence over the week following.	1. Placebo inhalers 2. Online platform with video of PR professional, for example YouTube clip 3. Instruction sheets for reading of steps to take medication.

Definition of abbreviations: COPD = chronic obstructive pulmonary disease; PR = pulmonary rehabilitation.

program completion and long-term healthy behavior change.

- Providing for faculty development (teaching about teaching) to PR professionals, who are the educators in PR, including feedback on their teaching practices. This includes both delivery and design of education in the PR program. Evaluation of the impact of expert PR educators in terms of health outcomes and cost–benefit analysis is needed.

Conclusions

Learning in PR has been at the heart of the intervention, with the inclusion of education since its inception, but, given our increased understanding of learners and the learning process, it is important to improve delivery and outcome assessment of the education component. It appears that addressing how individuals with COPD are educated will require not only a better understanding of people who are completing PR, such as screening of psychological and cognitive factors, but also individualizing delivery and tailoring content based on learning needs and health literacy issues. The consensus of the Workshop Committee is that education should remain a key feature of PR. However, to improve adherence and increase benefits of PR, it is essential that programs take the next steps of redefining education in PR through enhanced assessment of patients, tailoring

educational activities, and evaluating the impact of education on learning, self-management, behavior change, and clinical outcomes to advance PR for the future. ■

This official workshop report was prepared by an *ad hoc* subcommittee of the American Thoracic Society, the Thoracic Society of Australia and New Zealand, the Canadian Thoracic Society, and the British Thoracic Society.

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