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To cite this article: Ana Maria Ilicic, Dina Brooks, Michelle Kho, Roger Goldstein & Ana Oliveira (2023): Cough Assessment and Management in Pulmonary Rehabilitation– A Canadian Survey, COPD: Journal of Chronic Obstructive Pulmonary Disease, DOI: [10.1080/15412555.2022.2141622](https://doi.org/10.1080/15412555.2022.2141622)

To link to this article: <https://doi.org/10.1080/15412555.2022.2141622>



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Published online: 19 Jan 2023.



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Cough Assessment and Management in Pulmonary Rehabilitation– A Canadian Survey

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ABSTRACT

Pulmonary rehabilitation is a cornerstone intervention for controlling respiratory symptoms in people with chronic respiratory diseases. Chronic cough affects up to 90% of people with chronic respiratory diseases, however, it is currently unknown whether chronic cough is assessed and/or managed in pulmonary rehabilitation. This study aimed to determine if and how chronic cough is assessed and managed in pulmonary rehabilitation. This was a cross-sectional study. Pulmonary rehabilitation programs in Canada were identified *via* online websites. A representative from each program was invited to complete an online survey including the following topics: program demographics, assessment and management practices, and barriers and facilitators. Of 133 programs contacted, 31 returned a completed survey (23% response rate). Approximately half (52%) of respondents reported enrolling patients with chronic cough. Of those, 45% reported assessing and 62% reported intervening in chronic cough. Inadequate knowledge of assessment and management techniques was commonly identified to be a barrier and increased education was suggested as a possible facilitator. Based on pulmonary rehabilitation programs that responded to our survey, chronic cough is a prevalent symptom; however, it is scarcely assessed and managed. A need for structured education and the use of standardised strategies were reported as facilitators to the assessment and management of chronic cough in pulmonary rehabilitation.

ARTICLE HISTORY

Received 22 July 2022
Accepted 14 October 2022

KEYWORDS

Chronic obstructive pulmonary disease (COPD); lung disease; management; rehabilitation; questionnaire

Introduction

Chronic respiratory diseases affect over three million Canadians, COPD, asthma, and ILD, being some of the most prevalent in Canada [1]. Despite each disease differing in their underlying pathophysiology, many have similar clinical presentations, including dyspnoea and chronic cough [2]. Dyspnoea has been largely studied [3], but there is limited information regarding the assessment and management of chronic cough.

Cough is one of the most important sensory reflexes needed for survival [4]. However, when the cough becomes chronic, i.e. persists for 8 weeks or more, and is triggered by innocuous stimuli, such as talking, laughing, and exercising; it can have a serious impact on patients' daily lives [5]. A cough due to an underlying disease may be relieved when treating the primary cause; however, if it persists despite medical treatment for other health conditions, it is known as a refractory chronic cough [6]. Prevalence rates of chronic cough, either refractory or with an underlying cause, has been on a rise, with a reported prevalence of

16-18% in Canada [7], and can rise up to 90% in those with a chronic respiratory disease [8].

The burden of chronic cough is severe for patients, healthcare services, and societies. A constant feeling of having something “stuck in the throat”, coughing to low levels of stimulation, and inability to stop coughing are reported [9]. Cough can also be related to urinary incontinence, poor sleep, difficulties with relationships and social interactions, and work-related problems (55% productivity loss with costs of \$11,610 per employee/year) [10]. This can affect a patient's physical and mental health (e.g. fatigue, anxiety, and depression) [11]. Additionally, its impacts have been aggravated by the stigma associated with coughing during COVID-19 pandemic.

Chronic cough can be managed using pharmacological and non-pharmacological interventions. Non-pharmacological interventions may involve cough suppression for non-productive cough [12, 13] and cough augmentation for productive cough [14]. Cough control therapy (CCT) can be delivered by physiotherapists or speech-language

pathologists, and it includes several components such as education, laryngeal hygiene, cough suppression techniques, breathing exercises, and counselling [15]. The underlying mechanisms of CCT are still scarcely studied but are known to improve cough reflex sensitivity, cough frequency, and cough related quality of life [15]. CCT has been shown promising results for people with refractory chronic cough [15] with no adverse effects.

Pulmonary rehabilitation (PR) is a multidisciplinary, comprehensive, evidence-based intervention used to improve symptoms, exercise capacity, and quality of life in those who have chronic respiratory diseases [16–18]. Two important core components of PR, education on behaviour change and promotion of hydration and breathing techniques [16, 19], are also components of CCT [20]. However, no clinically significant improvements have been reported from PR on cough [21, 22], as there is no focus on cough education and suppression in PR [23].

Therefore, this study aims to determine if chronic cough is assessed and/or managed in PR. We also seek to identify how chronic cough is assessed and managed in PR, what factors impact chronic cough assessment and management, and barriers and facilitators to chronic cough assessment and management.

Methods

Survey instrument development

This was a cross-sectional survey study conducted across Canadian PR programs and developed according to the Consensus-Based Checklist for Reporting of Survey Studies (CROSS), seen in [Supplementary Material A](#). The survey questionnaire was developed using a similar format to those of previous PR surveys [2, 24], with the addition of cough-specific questions. The survey was divided into the following domains: demographic characteristics of the PR program (type of PR program, such as inpatient vs. outpatient, program capacity, and composition of the healthcare team); cough assessment (method of cough assessment, outcome measures used, and differences assessing cough among different respiratory chronic diseases); cough management (interventions used and differences between the management of productive and non-productive cough, as well as among different respiratory diseases); barriers and facilitators to cough assessment and management [2, 24]. The online survey was generated using LimeSurvey (LimeSurvey GmbH, Hamburg, Germany) and was tested by two additional members of the study team and piloted by another healthcare professional experienced in PR. The healthcare professional testing the survey was asked to comment on 1) observations regarding survey informational aspects, 2) comprehensiveness and clarity, 3) easiness of navigation, 4) grammar and spelling, and 5) time for completion. The survey was revised based on this feedback. The time to complete the survey was between 15 and 20 min. To account for human input error, the survey software forced the entry of only numbers for numeric

questions, for example, and informed participants if mandatory questions have not been filled. The survey can be found in [Supplementary Material B](#).

Study design and participant recruitment

The population of this study consisted of PR programs in Canada. Programs were identified through lists obtained from the Canadian Thoracic Society (CTS) and from provincial and municipal healthcare websites. Programs were contacted by email or phone to confirm their eligibility to participate (i.e. currently delivering PR) and to identify a member of the PR program who could answer the survey in representation of that program. This member had to be a healthcare provider, working with patients in PR, to qualify for answering the survey.

Procedure

This study obtained ethics approval from the Hamilton Integrated Research Ethics Board (HiREB) in May 2021 (Project ID: 13097). The representatives of the identified PR programs were sent an introductory email describing the study purpose and rationale, along with the guarantee that confidentiality would be maintained. The email also contained the survey hyperlink. Digital consent was obtained via LimeSurvey by asking participants to click on the “agree” box on the first page of the survey if they were willing to participate. Reminder emails were sent two, four, and six weeks after the initial email [2, 24]. The survey recruitment occurred between September 2021 and December 2021.

Data analysis plan

Descriptive statistics were used to describe data for survey variables, using means and standard deviation (SD), as well as medians and interquartile ranges (IQR), where applicable. Statistical analyses were computed using Microsoft Excel (Microsoft Corporation, USA). As this study is exploratory and preliminary, no sample size calculation was performed. Missing data was not imputed [25].

Results

Program characteristics

A total of 133 PR programs were invited to participate. Of those, 31 completed the survey (23% response rate). Response rate was defined as the number of responses received divided by the total number of PR programs invited to participate. Eighty-seven programs (85%) provided no reason for declining participation, 14 (14%) stated that they were unwilling with no reasons given, and 1 (1%) was not able to respond accurately.

Table 1 indicates a breakdown of PR program characteristics. Survey responses were collected across six provinces: Ontario ($n=7$; 32%), British Columbia ($n=5$; 23%),

Table 1. PR program characteristics.

Locations in Canada, n (%)	
Unreported*	9 (29.0)
ON	7 (22.5)
BC	5 (16.1)
SK	4 (12.9)
AB	3 (9.7)
Eastern Provinces (PEI, NB)	2 (6.5)
MB	1 (3.2)
Healthcare professionals, n (%)	
Respiratory Therapist	13 (42.9)
Physiotherapist	8 (25.8)
Nurse	6 (19.4)
Other*	6 (18.1)
Years of experience, mean (SD)	8.6 ± 6.0
Type of program offered, n (%)	
Out-patient	27 (93.1)
Maintenance	12 (42.9)
Home Program	9 (31.0)
In-patient	1 (3.6)
Virtual Out-patient	1 (3.6)
Number of patients with chronic cough median (Q1-Q3)	50 (28.75 – 80.0)

Legend: AB, Alberta; BC, British Columbia; IQR, interquartile range; MB, Manitoba; NB, New Brunswick; ON, Ontario; PEI, Prince Edward Island; SD, standard deviation; SK, Saskatchewan.

*Unreported: Refers to healthcare providers not reporting the geographical location of the PR program.

**"Other" includes kinesiologists (n=2; 6.5%), an exercise physiologist, (n=1; 3.2%), a respirologist (n=1; 3.2%), an exercise therapist (n=1; 3.2%), and a personal trainer (n=1; 3.2%).

Saskatchewan (n=4; 18%), Alberta (n=3; 14%), Manitoba (n=1; 4%), Prince Edward Island (n=1; 4%), and New Brunswick (n=1; 4%). Nine survey respondents' locations were unidentified. No PR programs were identified in Yukon, Northwest Territories or Nunavut. The PR programs were mainly outpatient (n=27; 93%). Most surveys were completed by respiratory therapists (n=13; 42%), followed by physiotherapists (n=8; 26%) and nurses (n=6; 19%), with an average of 8.6 ± 6.0 years of experience working in PR.

Program characteristics for each type of PR program offered is in Figure 1. Maintenance programs reported enrolling more patients at a given time, with longer session durations. Several respondents (n=7; 58%) reported that their maintenance programs run indefinite and we were

not able to be included in some of the data on time duration. Only programs with fixed time duration were included in the figure.

Of the 31 PR programs completers, the majority reported that COPD was the most represented patient diagnosis in PR (median 80%; Q1 30% – Q3 100%) and half (median 50%; Q1 28.75% – Q3 80%) reported having patients presenting with a chronic cough. The median distribution of respiratory diseases managed in PR programs is presented in Figure 2.

Cough assessment

Table 2 provides details regarding cough assessment. Fourteen respondents (45%) reported assessing chronic

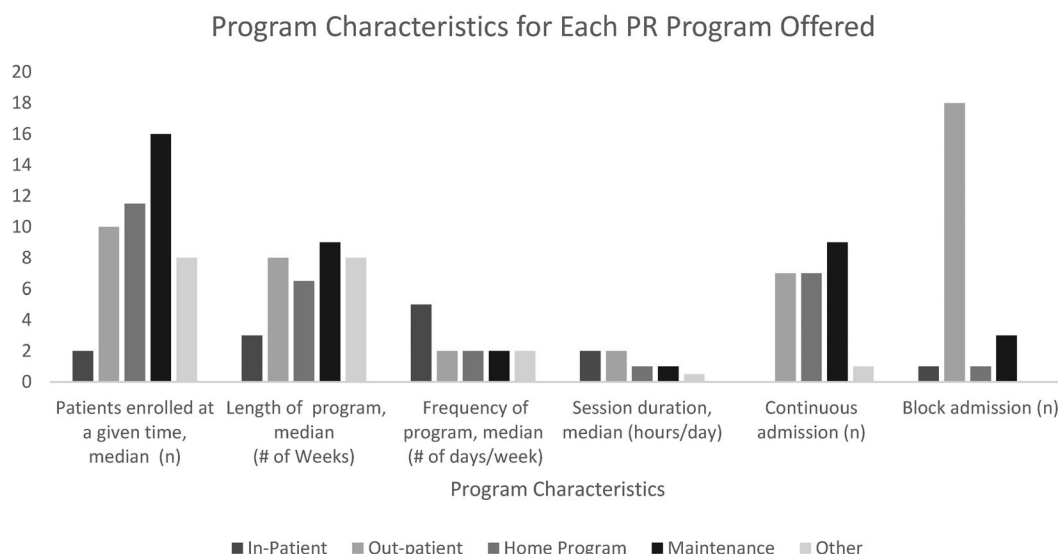


Figure 1. Program characteristics based on type of pulmonary rehabilitation program offered. **"Other" type of PR offered included virtual PR. To note, many maintenance programs run indefinitely and on rolling admission.

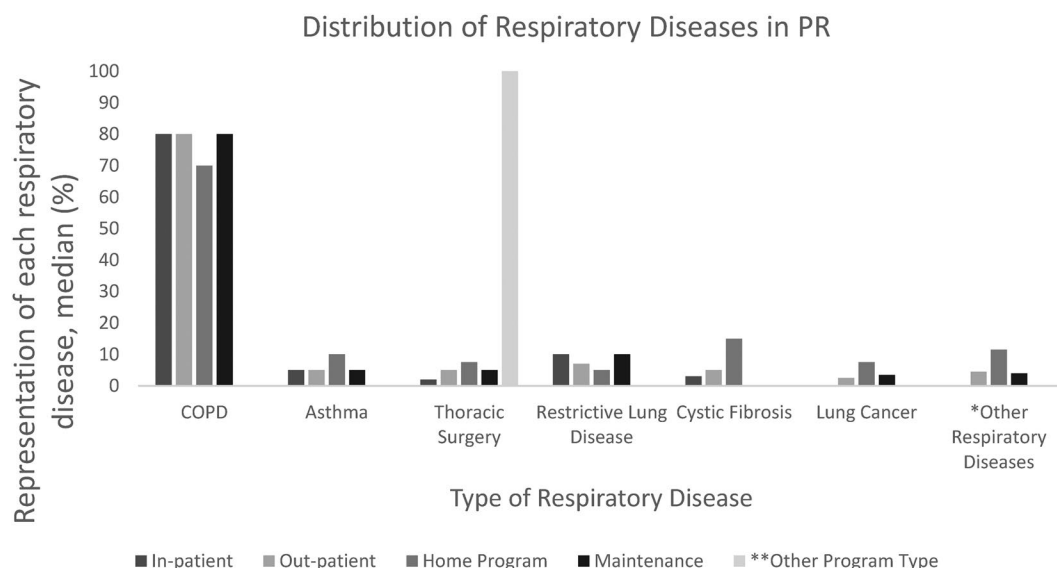


Figure 2. Distribution of respiratory diseases managed in pulmonary rehabilitation programs. **"Other Respiratory Diseases": respiratory diseases managed in PR include bronchiectasis, pulmonary hypertension, embolism, empyema, bullae, pneumothorax, atelectasis, obesity hypoventilation syndrome, post-covid symptoms. ** "Other Program Type": Out-patient virtual program

Table 2. Assessment of chronic cough in PR programs.

Healthcare professional assessing cough, n (%)	
Physiotherapist	7 (50.0)
Respiratory Therapist	6 (42.9)
Nurse	4 (28.6)
Exercise Physiologist	1 (7.1)
Kinesiologist	1 (7.1)
Assessment point, n (%)	
Beginning of Program	14 (100)
End of Program	7 (50.0)
Monthly	3 (21.4)
Each Session	2 (14.3)
As Needed	2 (14.3)
Weekly	1 (7.1)
Outcome measures, n (%)	
Patient History	13 (92.9)
Questionnaire/Scale	8 (57.1)
Physical Examination	4 (28.6)
Objective Assessment	3 (21.4)
Other: As-needed basis	1 (7.1)
Aspects of cough assessed, n (%)	
Frequency of Cough	13 (92.9)
Type of Cough	12 (85.7)
Cough Triggers	12 (85.7)
Risk Factors for Cough	12 (85.7)
Duration of Cough	9 (64.3)
Relieving Factors	8 (57.1)
Impacts of Cough	7 (50.0)
Other: (Continence and sputum)	1 (7.1)

cough. Cough assessment was most frequently conducted at the beginning ($n=14$; 100%) and end of PR ($n=7$; 50%) by a physiotherapist ($n=7$; 50%) or respiratory therapist ($n=6$; 43%). The assessment included mainly the patient's history ($n=13$; 93%) and cough questionnaires and scales ($n=8$; 57%) to evaluate cough frequency ($n=13$; 93%), type of cough ($n=12$; 86%), cough triggers ($n=12$; 86%) and risk factors for cough ($n=12$; 86%). Items less commonly collected during the assessment are duration of cough ($n=9$; 64%), factors relieving cough ($n=8$; 57%) and impacts of cough ($n=7$; 50%). The distribution of healthcare providers assessing cough is presented in Figure 3 (A).

Cough management

Table 3 provides details of cough management. A total of 16 respondents (62%) reported managing chronic cough. Non-productive chronic cough was primarily managed through breathing exercises ($n=13$; 81%), education ($n=12$; 75%), medication ($n=11$; 69%), and smoking cessation ($n=10$; 63%). Less commonly, it was managed through airway clearance techniques ($n=8$; 50%), behaviour change techniques ($n=5$; 31%) and cough suppression techniques ($n=4$; 25%). Productive cough was managed using airway clearance techniques ($n=15$; 94%), medication ($n=12$; 75%),

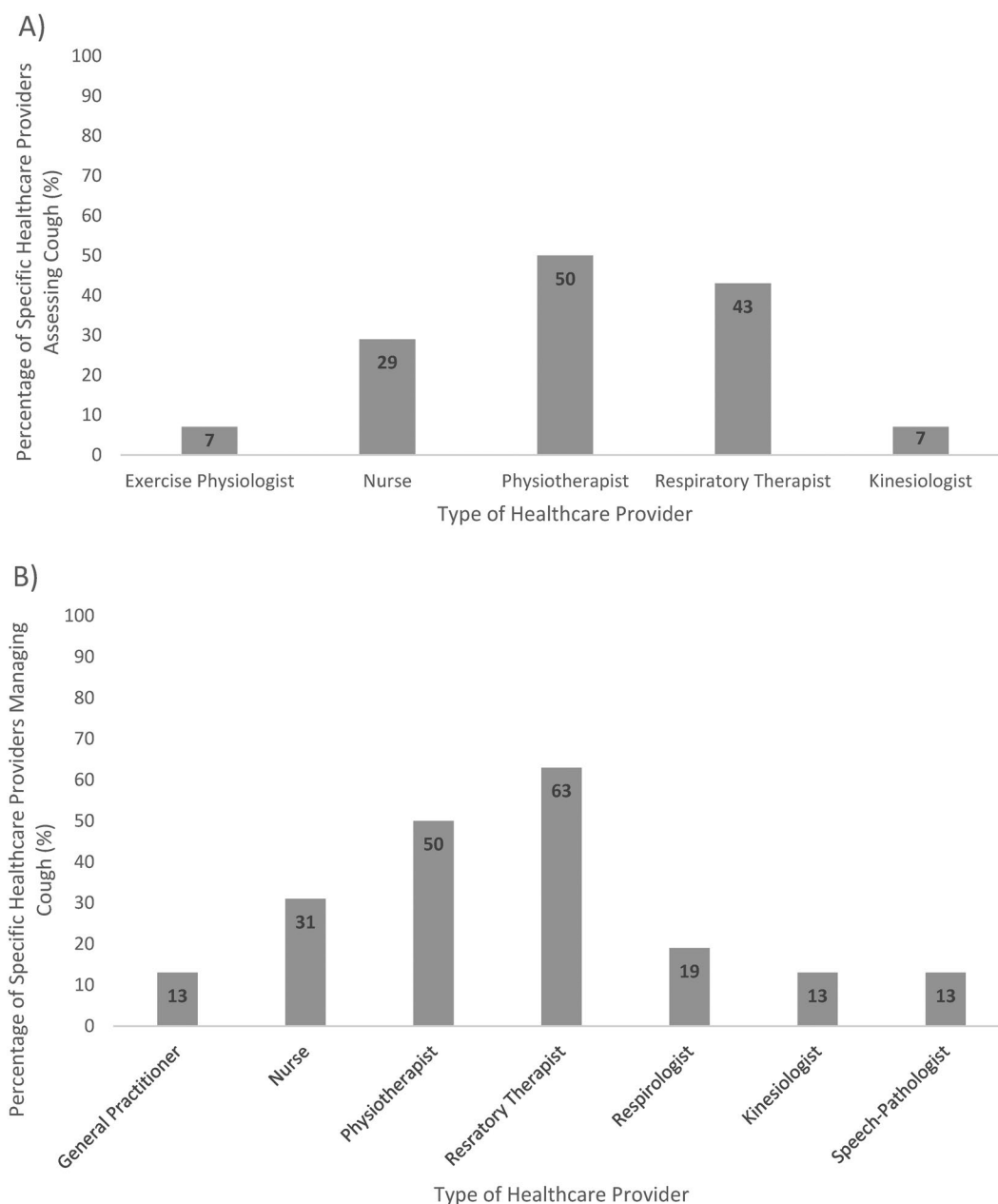


Figure 3. Healthcare providers (A) Assessing and (B) managing cough.

Table 3. Management of chronic cough in PR programs.

Techniques used, n (%)	
Non-productive Chronic Cough	
Breathing Exercises	13 (81.3)
Education	12 (75.0)
Medication	11 (68.8)
Smoking Cessation	10 (62.5)
Airway Clearance Techniques	8 (50.0)
Behaviour Change Techniques	5 (31.3)
Cough Suppression Techniques	4 (25.0)
Productive Chronic Cough	
Airway Clearance Techniques	15 (93.8)
Medication	12 (75.0)
Breathing Exercises	11 (68.8)
Smoking Cessation	9 (56.3)
Behaviour Change Techniques	6 (37.5)
Education	5 (31.3)
Cough Suppression Techniques	1 (6.3)

breathing exercises ($n=11$; 69%), and smoking cessation ($n=9$; 56%). The distribution of healthcare providers managing cough is presented in Figure 3 (B).

Most respondents surveyed, indicated that management strategies for chronic cough did not differ based on the respiratory diagnosis ($n=9$; 56%), or the severity of disease ($n=15$; 94%). Details of the different chronic cough management strategies provided based on diagnosis are summarised in Supplementary Material C (non-productive cough) and Supplementary Material D (productive cough).

Barriers and facilitators to cough assessment and management

The most commonly identified barrier for cough management was inadequate knowledge on how to assess ($n=10$; 83%) and treat ($n=6$; 60%) chronic cough. Other reported reasons for not assessing/managing chronic cough were lack of patients presenting with a chronic cough in PR ($n=2$; 67%), and lack of time ($n=1$; 33%).

The most commonly suggested facilitators for cough management included providing education and training to healthcare professionals on i) the benefits of PR on chronic cough, ii) valid assessment tools and outcome measures and iii) conducting cough assessment and management. The need for increasing the current staff of PR programs was also noted as a facilitator to conduct cough assessment and management in PR.

Discussion

This study shows that most respondents representing PR programs (52%) enrol patients with chronic cough, with 45% reporting assessing and 63% reporting managing chronic cough. Gathering of patient history, use of questionnaires and scales and physical examination were commonly ways for cough assessment. Breathing exercises were the most used strategy for non-productive cough management, while airway clearance techniques were common practice in the management of productive cough. Healthcare professionals also reported an insufficient understanding of cough assessment and management to implement it in their PR practice.

PR programs who responded to the survey do not routinely assess chronic cough, although about half of the PR programs reported having patients who present with it. The absence of formal evaluation using valid measurement tools likely contributes to the underestimation of the true number of people with chronic cough enrolled in PR programs and prevents a more detailed understanding of the cough characteristics and of the effectiveness of cough management techniques. A detailed history will provide important information regarding characteristics and triggers, as well as lifestyle and health-related behaviours, that may guide management strategies [26, 27], or referral to a cough specialist.

No respondents reported the use of cough-specific measures such as the Leicester Cough Questionnaire (LCQ), a patient reported outcome used in clinical trials and easy to

implement in clinical practice [28, 29]. The LCQ evaluates cough domains of physical, psychological and social health, takes 5 min to complete, and its use has been reported as valid, reliable, and responsive to therapy in COPD [29] and bronchiectasis [30, 31], namely to PR interventions [21]. Its evaluation, predominantly on the impact of cough symptoms on health related quality of life, means that it provides limited information on other cough characteristics such as cough severity [32]. Encouraging recent research efforts have focussed on the characteristics of cough identified by patients, including urge to cough sensations and cough symptoms, as a prelude to the development of a more comprehensive cough questionnaire [9]. Cough counters are considered the gold standard for cough frequency assessment [30, 33] but none of the respondents used them as assessment tools. Similarly, automated solutions using smartphone technology have been reported for those with asthma and chronic refractory cough, but are not yet in widespread use pending studies of feasibility and validation [7, 8, 34].

Once characterised, optimal management differed in PR programs, between productive and non-productive cough. With airway clearance techniques and medication being used for productive chronic cough [35] and breathing exercises plus education to personalise strategies for non-productive cough management. In a recent review of non-pharmacological cough management by our group, we reported that multi-component therapies incorporating both breathing exercises and cough education were the most effective non-pharmacological treatment in improving cough-related quality of life [12]. Similarly, in a recent meta-analysis, Wamkpah and colleagues noted that non-pharmacological multi-component therapies delivered by speech-language pathologists or physiotherapists had positive effects in improving cough and cough-related outcomes [13].

Despite the use of antitussive drugs for non-productive chronic cough management has limited efficacy and frequent side-effects [36], 69% of respondents reported using them for non-productive chronic cough, likely because of lack of education of both healthcare providers and patients on alternative approaches even including smoking cessation. Healthcare professionals surveyed identified the need for more education to adequately assess and manage chronic cough in PR. Despite national and international professional respiratory organisations have published guidelines on the management of lung disease [37, 38], there has been minimal training of rehabilitation providers on the management of chronic cough in PR [39]. The latter presents a unique opportunity as patients have frequent contact with healthcare professionals over several weeks, an ideal environment for reinforcing and supporting learning.

Implications for practice and research

This study shows that patients enrolled in PR programs across Canada commonly present with chronic cough, however some healthcare professionals lack systematised knowledge and education on how to assess and manage them. Knowledge translation of effective existing therapies would

seem a natural step even as tools and treatments continue to be better refined. PR programs provide an important opportunity to improve the wellbeing of those with refractory chronic cough. Our observations should be expanded to improve accuracy and assess generalisability across jurisdictions.

Strengths and limitations

This is the first study to call attention to the unmet needs of healthcare professionals working in PR programs, where their primary patient population often presents with a chronic cough, however healthcare professionals voiced concerns on limited knowledge and resources for its management. The survey highlights their needs and recommendations for further guidance on how to address patients presenting with a chronic cough in PR and demands for more research and educational support in this field.

The main limitation of this study is the low response rate. Data was collected during the 4th and 5th waves of COVID-19 in Canada [40]; a period in which many rehabilitation programs were either closed, operating in-person, with limited capacity, or converted to online programs [41, 42]. Programs that continued to operate required serious and quick adaptations, which resulted in an increased pressure for the rehabilitation team [43]. Thus, it is not surprising that research studies conducted during COVID-19 are associated with lower response rates when compared to similar studies conducted during previous times. In fact, low response rates have been widely reported in Canadian studies during the COVID-19 pandemic. Although we acknowledge that different results may have been analysed had the study been conducted at a different time, we strongly emphasise that there is currently no consensus on what constitutes of an acceptable response rate [44–46]. Furthermore, our survey was able to gather data from most of the provinces in Canada (6/10 provinces), providing an acceptable overview of programs around the country.

Although recruiting and collecting data online, through the use of surveys, is convenient, inexpensive, and has the potential of driving research during times of limited in-person contact, such as pandemics, it is not without its limitations. Particularly, in this study, limitations may have included sampling bias, such as missing eligible PR programs, where PR program information was not available online, having only responses from programs which were interested in the topic of ILD and chronic cough, and the inability to clearly ensure the programs that responded met the eligibility criteria [47, 48]. Aware of such limitations, we sought to minimise their impact on the results, namely by also obtaining lists and contact information of programs directly from the CTS and from provincial and municipal healthcare websites; as well as by calling and emailing such programs to check for their eligibility. We have also followed the CROSS to more accurately and transparently report our methodology and to allow for an unbiased interpretation of our results.

Lastly, cough characteristics of patients enrolled in PR (i.e. refractory, of known cause, idiopathic, etc.) were not evaluated. Having a detailed history about the patients' cough would be beneficial to clarify the nature of their cough and of the treatment needed. However, characterising the cough of patients in PR programs was out of the scope of this study. Rather, we sought to evaluate if healthcare centres were well equipped to provide basic access to cough management, independently of the cough characteristics. Following these results, further research is desirable to describe the characteristics of the cough of patients attending PR, using objective and patient-reported measures. This information will be valuable to best direct the educational initiatives on managing chronic cough for healthcare providers in PR.

Conclusion

Despite more than half of respondents reported enrolling patients with chronic cough, only 45% reported assessing and 63% reported managing it. Lack of formal education on how to assess and treat chronic cough was the main barrier identified. Cough is a burdensome symptom and sign. The application of formal assessment using valid tools will facilitate our understanding of its characteristics as well as the impact of treatment strategies that can be implemented as part of a PR program.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

Dr. Dina Brooks holds a National Sanitarium Association (NSA) Chair in Respiratory/Pulmonary Rehabilitation Research. Dr. Michelle Kho holds a Canada Research Chair in Critical Care Rehabilitation and Knowledge Translation. Ana Maria Ilicic holds the Diane and Colin Wood Bursary in Respiratory Health.

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