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ORIGINAL RESEARCH ARTICLE

COPD-Specific Self-Management Support Provided by Trained Educators in Everyday Practice is Associated with Improved Quality of Life, Health-Directed Behaviors, and Skill and Technique Acquisition: A Convergent Embedded Mixed-Methods Study

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Abstract

Background There is a necessity to better document the effect of continuing education activities targeted at respiratory educators providing self-management support for patients with chronic obstructive pulmonary disease (COPD). We therefore sought to describe real-life COPD-specific self-management support delivered by respiratory educators who participated in a lecture-based continuing education activity and assess the outcomes of patients with COPD.

Methods We conducted a convergent embedded mixed-methods study. Respiratory educators attended a 7-h, lecture-based continuing education activity on self-management support held in Québec, Canada. Four months after the continuing education activity, in their professional practice, trained educators provided self-management support to patients with COPD. One month later, to describe the components of self-management support provided, individual telephone interviews were conducted with educators. Interviews were transcribed verbatim and were qualitatively analyzed. Before self-management support and 6 months afterwards, we assessed the following clinical outcomes of patients with COPD: (1) quality of life (St. George's Respiratory Questionnaire for COPD patients, Impact domain; score 0–100; minimal clinically important difference = − 4; telephone administered); (2a) whether patients had one or more unscheduled doctor visit, (2b) one or more emergency room visit, and (2c) one or more hospitalization in the 6 preceding months (Survey on Living with Chronic Diseases in Canada; telephone administered); and (3a) health-directed behaviors and (3b) skill and technique acquisition (Health Education Impact Questionnaire; score 1–4; self-administered at home). We used mixed models to estimate mean differences and prevalence ratios, with associated 95% confidence intervals.

Results Trained respiratory educators (nurse: $n = 1$; respiratory therapist: $n = 3$; ≥ 15 years of experience of care with patients with chronic disease) invited 75 patients with COPD to participate in the study. Fifty-four individuals with COPD (age, mean ± standard deviation: 68 ± 8 years; men: $n = 31$) were enrolled and received self-management support. Qualitative analyses revealed that self-management support consisted of one to two visits that included: (1) provision of information on COPD; (2) training in inhalation technique; and (3) smoking cessation advice. No educator reported implementing two or more follow-up visits because of a lack of time and human resources in their work setting. Among patients with COPD, improvements in quality of life were clinically important (adjusted mean difference = − 12.75; 95% confidence interval − 18.79 to − 6.71; $p = 0.0001$). Health-resource utilization was not different over time (all p values > 0.05). Improvements in health-directed behaviors and skill and technique acquisition were statistically significant (health-directed behaviors: adjusted mean difference = 0.50; 95% confidence interval 0.23–0.77; $p = 0.0005$; skill and technique acquisition: adjusted mean difference = 0.12; 95% confidence interval 0.01–0.23; $p = 0.0293$).

Conclusions Following a 7-h, lecture-based continuing education activity on COPD-specific self-management support, respiratory educators with significant experience of care provided self-management support that included provision of

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information, inhalation technique training, and smoking cessation advice. This resulted in enhanced patient quality of life, health-directed behaviors, and skill and technique acquisition. To decrease health resource utilization, the training could employ active learning methods. More time and resources could also be devoted to implementing regular follow-up visits.
Clinical Trials Registration No NCT02870998.

Key Points

Respiratory educators who participated in a lecture-based continuing education activity on self-management support provided self-management support for patients with chronic obstructive pulmonary disease that included provision of information, self-management training, and lifestyle advice in their work settings.

Real-life self-management support resulted in improved patient quality of life, health-directed behaviors, and skill and technique acquisition among patients with chronic obstructive pulmonary disease.

We recommend employing active learning methods to see if they help educators to assist patients with chronic obstructive pulmonary disease in learning how to implement self-management activities. This may in turn, have the potential to reduce health resource utilization.

1 Background

Chronic obstructive pulmonary disease (COPD) is an irreversible but treatable respiratory disease characterized by airway obstruction. About 12% (95% confidence interval [95% CI] 8–15) of individuals experience COPD worldwide [1]. From 1990 to 2015, the global COPD prevalence increased by 44% (42–47%), mainly owing to population aging [2].

Chronic obstructive pulmonary disease is associated with diminished quality of life [3]. People with COPD are also often diagnosed with comorbid conditions, such as cardiovascular disease [4, 5], metabolic disease [4], anxiety and depression [6], and neoplasms [7, 8], which results in increased health resource utilization and, thereby, COPD-associated costs [4]. Yearly, direct healthcare expenditures of COPD have been estimated at US$30 billion in the USA [9], CAN$2 billion in Canada [10], and €12 million in the UK [11, 12].

To address the substantial burden of COPD, healthcare professionals are required to provide self-management support (SMS) for patients with COPD. These healthcare professionals who provide SMS are referred to as respiratory educators, hereafter. Through SMS, respiratory educators assist patients in self-managing COPD to optimize disease control and quality of life and minimize its untoward consequences [13]. According to the Practical Reviews in Self-Management Support (PRISMS) taxonomy, SMS has several components including: (1) provision of evidence-based information on COPD and its management; (2) provision of COPD action plans for the management of COPD exacerbations; (3) training in practical self-management activities (e.g., adequate inhalation techniques); (4) training to communicate with healthcare professionals to enhance shared decision making; and (5) regular clinical reviews [13]. Self-management support can also be coupled with a pulmonary rehabilitation program (exercise training) [14].

In a Cochrane meta-analysis, Zwerink et al. [15] suggested that SMS improves quality of life and reduces healthcare utilization. However, later trials reported controversial results [16–18]. Notably, Fan et al. [19] stopped their randomized controlled trial because of a three-fold excess of all-cause mortality estimated within the group of patients allocated to SMS (number of deaths over 1 year: SMS: $n=28/209$; usual care: $n=10/217$; $p=0.003$) [19]. Although these results could not be fully explained because of limited available data [19], implementation of SMS, as well as educators' training, have been called into question [20].

Training educators has been highlighted as an important aspect of successful SMS for patients with chronic obstructive disease [20–24]. However, there is a need to better describe and understand the effect of continuing education (CE) activities targeted at respiratory educators [20, 21]. In Québec, Canada, the Réseau québécois d'éducation en santé respiratoire [Québec Respiratory Health Education Network] is a not-for-profit organization that had been providing a lecture-based CE activity on SMS for > 200 respiratory educators since 2009 [25]. Recently, two explanatory studies assessed patient outcomes associated with SMS delivered by respiratory educators who attended this lecture-based CE activity [26, 27]. In these studies, and in accordance with the CE activity content, SMS was defined as the provision of four individual, clinic-based, and face-to-face disease-specific SMS sessions over a 1-year period, i.e., one 90-min initial visit and three 60-min follow-up visits at 4–6 weeks, 4–6 months, and after a year. At the beginning of each session, respiratory educators assessed each participant's educational needs and tailored their intervention accordingly. In

addition, each session included: (1) provision of information about asthma or COPD; (2) provision of a written action plan; (3) training in adequate inhalation techniques; (4) medication adherence support; and (5) smoking cessation advice. Educators provided their office phone number so patients had easy access to advice or support when needed. As a result, and under these ideal circumstances, SMS provided by trained educators was associated with improved quality of life and decreased health resource utilization among asthma and patients with COPD [26, 27].

The effect of SMS delivered by trained respiratory educators in everyday practice remains to be documented. In the present pragmatic study, we therefore sought to quantitatively evaluate whether SMS provided in everyday practice is associated with improved patient outcomes. To better understand our quantitative results, we also aimed to qualitatively describe real-life COPD-specific SMS provided by trained respiratory educators, organizational support, and educators' perception of patient outcomes associated with SMS.

2 Methods

2.1 Study Design

We conducted a convergent embedded mixed-methods study. The trial has been approved by the Institut universitaire de cardiologie et de pneumologie de Québec—Université Laval [Québec Heart and Lung Institute] Ethics Committee (approval number: MP-10-2016-2591). The protocol has been peer reviewed, published [28], and registered on ClinicalTrials.gov (NCT02870998). This article describes patient outcomes associated with respiratory educators' participation in a lecture-based CE activity on COPD-specific SMS based on the Expanded Outcomes Framework for Planning and Assessing Continuing Medical Education Activities [29]. In brief, respiratory educators attended a 7-h lecture-based CE activity on how to deliver COPD-specific SMS. Self-reported competence, knowledge application, and performance were respectively assessed among educators immediately after the lecture-based CE activity, as well as 1 or 2 months afterwards, as reported elsewhere [28]. Four months after the CE activity, educators provided SMS to individuals with COPD in their everyday practice. One month later, qualitative data were collected among respiratory educators to describe real-life SMS provided and organizational support, and to report perceived patient outcomes. In addition, and to evaluate COPD patient outcomes associated with COPD-specific SMS delivered by trained educators, quantitative data were collected among patients with COPD before the initial SMS session and 6 months afterwards.

2.2 Recruitment and Eligibility Criteria for Respiratory Educators and Individuals with Chronic Obstructive Pulmonary Disease (COPD)

Respiratory educators were eligible to participate in the study if they attended one of the CE activity sessions on COPD-specific SMS organized by the Québec Respiratory Health Education Network in June 2016, November 2016, and October 2017. A member of our research team was present at each CE activity session to invite attendees to participate in the study. Participating respiratory educators were then asked to invite the next approximately five to ten individuals with COPD who were scheduled for SMS to participate in the present study.

All patients with physician-diagnosed COPD, who were scheduled to meet the participating respiratory educators for SMS, were eligible. Educators invited patients to participate in the study when scheduling the initial visit. They communicated contact information of patients with COPD, who accepted the invitation, to the study coordinator. Later, trained research assistants called patients with COPD and recruited them. All participating respiratory educators and patients with COPD provided informed consent.

2.3 Interventions

2.3.1 Lecture-Based Continuing Education Activity on Self-Management Support (SMS) Targeted at Respiratory Educators

All participating respiratory educators attended a 7-h lecture-based CE activity organized by the Québec Respiratory Health Education Network. The CE activity was delivered by an experienced nurse. Its general objective was, for educators, to be able to provide COPD-specific SMS in their work settings. The content of the CE activity was based on national guidelines and international expert consensus reports [30–32]. At the end of the CE activity, educators were expected to achieve several specific learning objectives, which are reported elsewhere [28]. These objectives pertained to the following SMS components, based on the PRISMS taxonomy [13]:

1. Training for practical self-management activities, e.g., to demonstrate how to teach a patient to use and maintain medication delivery devices;
2. Provision of action plans for the management of COPD exacerbations, e.g., to demonstrate how to teach a patient to use an action plan;

3. Provision of advice and support around lifestyle, e.g., to support patients concerning smoking cessation;
4. Regular clinical reviews, e.g., to perform follow-up visits.

One month after the CE activity, the achievement of the specific learning objectives was assessed among trained educators. To this end, educators filled in a 13-item closed-ended questionnaire that also checked whether they were able to memorize the concepts pertaining to each specific learning objective. Attendees were required to have a score $\geq$ 9/13 to earn their continuing education units (all participating educators passed this exam). The extent to which the educators achieved the general objective of the CE activity was not formally assessed by the Québec Respiratory Health Education Network.

2.3.2 SMS for Patients with COPD

Trained respiratory educators provided real-life SMS to COPD individuals in their professional practice. Additional information in regard to the description of SMS provided can be found in Sect. 2.9.

2.4 Patient Outcomes

Among patients with COPD who met the trained respiratory educators, we assessed, before the first SMS session and 6 months afterwards, quality of life, health resource utilization, and health education impacts as follows.

2.4.1 Quality of Life

To measure quality of life, we used the validated Canadia–French version [33] of the Impact and Activity domains of the COPD-specific version of the St. George's Respiratory Questionnaire (SGRQ-C) [34, 35] and the validated COPD Assessment Test (CAT) [36]. We considered the Impact domain of the SGRQ-C, which focuses on disturbance of psychosocial function, as our primary outcome. The activity domain of the SGRQ-C measures disturbance to daily physical activities. The CAT is considered as a general measure of health status that focuses on COPD-related symptoms. We reported the measurement properties of these questionnaires elsewhere [28]. In the present study, the Cronbach's alphas of the SGRQ-C Impact domain, SGRQ-C Activity domain, and CAT were 0.785, 0.877, and 0.782, respectively. On the SGRQ-C, scores can theoretically range from 0 (perfect health) to 100 (most severe status) [34]. On the CAT, scores can range from 0 to 40 and a lower score indicates a better health status [36]. A 4-point difference in SGRQ-C scores and a 2-point change in CAT scores are considered as clinically important [37–39].

2.4.2 Health Resource Utilization

We used three items derived from the Survey on Living with Chronic Diseases in Canada (SLCDC) to measure the number of (a) COPD-related unscheduled doctor visits, (b) emergency room visits, and (c) hospitalizations in the 6 preceding months [40].

2.4.3 Proximal Outcomes of SMS

We used the Canadian-French version [41] of the Health Education Impact Questionnaire (heiQ) to measure eight proximal outcomes of SMS [42], including health-directed behaviors (i.e., change in lifestyle related to healthful behaviors, including tobacco abstinence) and skill and technique acquisition (i.e., knowledge-based skills and techniques to effectively manage COPD-related symptoms or exacerbations) [43]. The theoretical structure of the heiQ was derived from a review of current practice, the development of a program logic, concept mapping, and rigorous item development, testing, selection, and validation in an independent sample [43]. The heiQ was originally validated among Australian English-speaking patients with chronic diseases [43, 44]. Later, it was translated in French and validated among Canadian French-speaking patients with COPD [45] and patients with cancer [41]. In the present study, all Cronbach's alphas related to any one of the heiQ domains were $>$ 0.70 (i.e., acceptable [46]), except for the Self-Monitoring and Insight domain (Cronbach's alpha = 0.593) and Skill and Technique Acquisition domain (Cronbach's alpha = 0.682). Each heiQ domain score can range from 1 to 4, with higher scores indicating better outcomes [43]. Meaningful improvements in heiQ scores, as derived from baseline to follow-up standardized effect sizes, vary from one domain to another, but range from 0.19 to 0.42 [47].

2.5 Confounding Variables

Determinants of patient health outcomes identified a priori and other variables used to further describe our study participants were measured, including anxiety and depression (through the Hospital Anxiety and Depression Scale [HADS] [48]). The detailed list of variables collected can be found elsewhere [28].

2.6 Sample Size

Based on sample size calculations reported elsewhere [28], we estimated that a sample size of 52 patients was required to detect a within-group change at the 6-month follow-up equivalent to −2 points on the impact domain of the SGRQ-C in our group of patients with COPD (standard deviation = 19; type II error = 0.20, or 80% power; type I error = 0.05; two-sided test). To account for possible 20% losses to follow-up, 65 patients with COPD had to be recruited. Our recruitment target was approximately five patients per educator.

2.7 Data Collection

Before the first SMS session and 6 months later, trained research assistants called patients with COPD and administered the SGRQ-C, CAT, and SLCDC over the phone. After their telephone call, research assistants were instructed to mail the heiQ and HADS to patients, who were asked to complete it at home, before SMS, and to send it back to the research team, by using pre-addressed and stamped envelopes. The heiQ was also mailed to patients 6 months later. To avoid missing data, interviewers could also administer the heiQ and HADS on the phone, upon patient request.

2.8 Statistical Analyses

Baseline characteristics of patients with COPD were summarized using means and standard deviations, medians, or frequencies (n) and percentages. The number of COPD-related unscheduled doctor visits, emergency room visits, and hospitalizations was dichotomized as 0 or ≥ 1 event. Data were analyzed by intention to treat [49]. We compared changes in scores or proportions before and after SMS, using hierarchical generalized linear or log-binomial mixed models [50], respectively. We calculated mean differences (MDs) or proportion ratios with corresponding 95% CIs [50, 51]. All determinants of outcomes identified a priori were included in statistical models if they resulted in a > 10% change in the differences in means (or proportion ratios) [52]. We examined residual distributions to assess model assumptions and goodness-of-fit [50, 51]. We used the 9.4 version of SAS (Cary, NC, USA) to conduct all statistical analyses and two-sided p values with an $\alpha \leq 0.05$ level of significance for all tests.

2.9 Qualitative Analyses

Five months after the CE activity, we conducted semi-structured telephone interviews with all the participating respiratory educators, using an interview guide described elsewhere [28]. This enabled us to describe the components of SMS provided across settings, the organizational support (a factor reported to impact on patient outcomes [53] and that needs to be qualitatively assessed [54]), as well as to assess patient outcomes from the educators' point of view. The study coordinator conducted and audiotaped all the telephone interviews. During these interviews, respiratory educators were in each of their own professional settings. Interviews were transcribed verbatim by a research assistant and the accuracy of transcripts was checked, i.e., a member of our study team checked randomly selected extracts to ensure that there were no mistakes. The transcripts were imported to QSR NVivo 11 software® for content analysis [55]. To describe SMS provided in every professional practice, transcripts were coded by the study coordinator according to the components derived from the PRISMS taxonomy [13]. To describe organizational support and perceptions of patient outcomes, a research assistant read and coded the first three interview transcripts by using a deductive approach [55] based on the framework by Moore et al. [29]. This assistant debriefed to refine the codebook with a member of our research team. Based on the refined codebook, the study coordinator then independently coded the first three interview transcripts. Based on a satisfactory inter-rater agreement (Krippendorff's $\alpha = 0.82$), the research assistant coded the last interview transcript. Codes were sorted into categories and the categories were grouped into themes. Themes, major findings, and illustrative quotations were taken back to the participating educators, who were provided with the opportunity to comment on them, as suggested by Creswell [56].

3 Results

3.1 Flow Chart

The flow chart of participants is displayed in Fig. 1. Overall, 75 patients with COPD were invited to participate in the study by four trained respiratory educators. Although all 75 patients were provided SMS, 54 patients were recruited to participate in the study (participation rate = 72%). Thirty-two patients with COPD were joined over the phone soon after the first SMS session to complete the study questionnaires. Five patients did not participate in the second phone call. Data were analyzed by intention to treat, i.e., all patients were included in data analyses, irrespective of whether they participated in one or two phone calls [49, 57].

3.2 Baseline Characteristics of Participating Respiratory Educators and COPD Individuals

Participating respiratory educators (nurse: $n = 1$; respiratory therapist: $n = 3$) were all women (aged 36–45 years: $n = 3$; aged ≥ 46 years: $n = 1$), had 18–39 years of professional

experience with the care of patients with chronic disease, and 2–11 years professional experience with the care of patients with COPD. Each month, they provided COPD-specific SMS to 1–17 patients with COPD.

The COPD patient population included 57% men and 43% women (Table 1). Most participants were married or in a relationship (46%), had completed at least high school (59%), were living with someone (56%), and 43% of them had an annual family income < CAN$25,000. The COPD stage was classified as severe for 59% of patients and 85% of them presented with a high symptom severity score (CAT score ≥ 10.0/40.0). Most patients had comorbidities. Based on their HADS score, 11% and 6% had anxiety and depression disorders, respectively.

3.3 Description of SMS Provided in Everyday Practice

Although the CE activity stressed the importance of scheduling regular SMS sessions (e.g., four), all participating educators reported delivering one to two SMS sessions to individuals with COPD in interviews because of limited time and resources. All educators also reported that these sessions served mainly to provide information on COPD and its management, teach inhalation techniques, and give advice about smoking cessation, even though the CE activity also underlined the importance of supporting patients to adhere to their treatments. Two educators stated that SMS was coupled with a pulmonary rehabilitation program in their work setting. None reported negotiating the self-management plan with patients, which would have reflected a shared decision-making approach. However, this topic was not covered by the CE activity.

3.4 Patient Outcomes

3.4.1 Quality of Life

In patients with COPD, who were provided real-life SMS by trained educators, improvements in quality of life were clinically important on the SGRQ-C Impact domain and measured disturbance of psychosocial function (Table 2). The adjusted mean SGRQ-C Impact score decreased from 41.45/100.00 before SMS to 28.70/100.00 afterwards (MD = − 12.75; 95% CI − 18.79 to − 6.71; $p = 0.0001$). Adjusted quality-of-life scores, as measured by the SGRQ-C Activity (disturbance to daily physical activities) and the CAT (symptoms) significantly improved over time. Changes in adjusted mean SGRQ-C Activity and CAT scores could be clinically important because the SGRQ-C Activity and

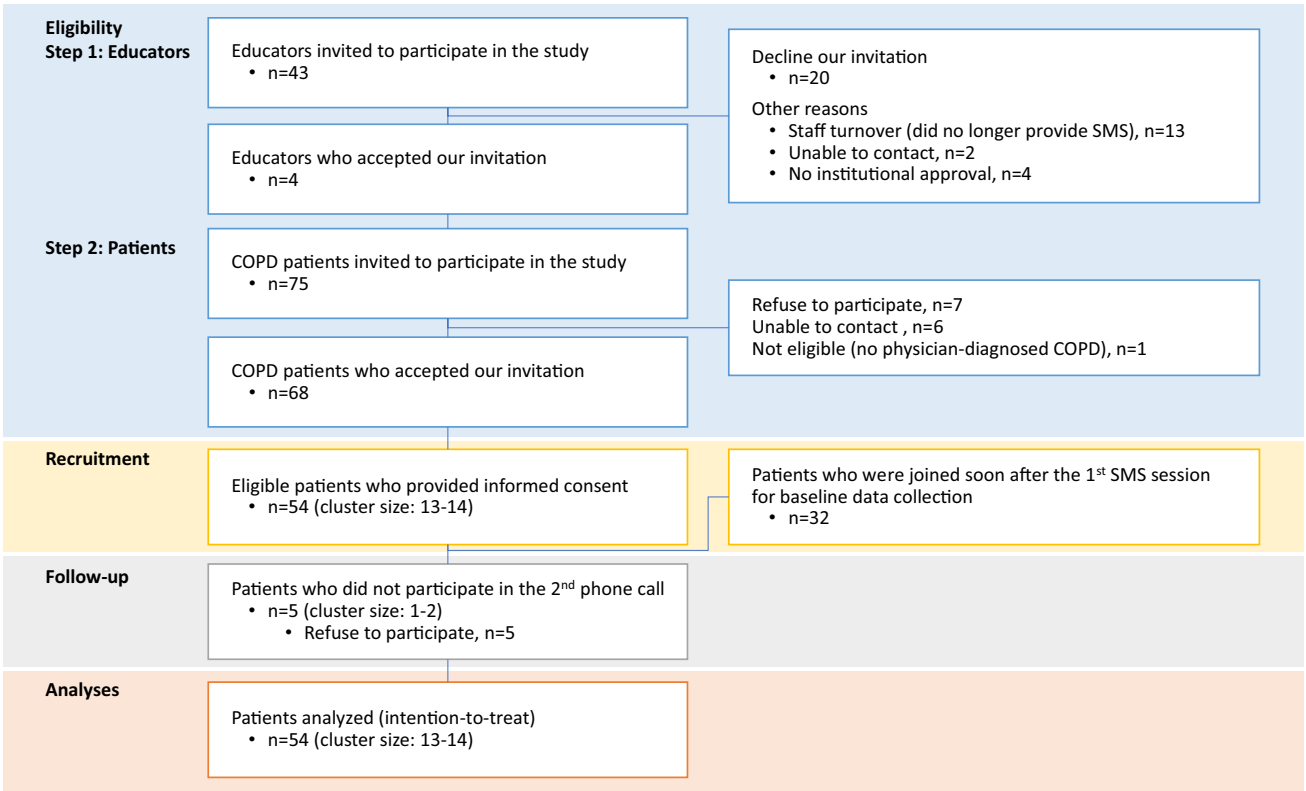

Fig. 1 Flow of participants through each stage of the study

Table 1 Baseline characteristics of patients with chronic obstructive pulmonary disease (COPD) [$N=54$]

Age, years	68 ± 8
Sex	
Male	31 (57)
Female	23 (43)
Marital status	
Single	4 (7)
Married or common-law relationship	25 (46)
Separated	5 (9)
Divorced or widowed	20 (37)
Living alone	24 (44)
Education, ≤ 12th grade	32 (59)
Annual family income, CAN$	
< 25,000.00	23 (43)
25,000.00–49,999.99	15 (28)
50,000.00–74,999.99	5 (9)
≥ 75,000.00	7 (13)
Missing	4 (7)
Body mass index, kg/m^2	26.01 ± 5.37
< 21[a]	10 (19)
≥ 21	4 (81)
Smoking history, number of packs/year[c]	41.25 [30.00–67.50] (0.00–157.50)
Disease severity[b]	
Severe	32 (59)
Moderate	16 (29)
Mild	6 (11)
Symptom severity	
CAT score ≥ 10	46 (85)
CAT score < 10	8 (15)
Previous exacerbation in the preceding 6 months[d]	29 (54)
Hospitalization in the preceding 6 months	12 (22)
Comorbidity	
Cardiovascular disease[e]	34 (63)
Neoplasm	9 (17)
Metabolic disease (e.g., diabetes mellitus, osteoporosis)	18 (33)
Respiratory tract infections in the previous 6 months	31 (57)
No social support[f]	7 (13)
Levels of anxiety, HADS-A score: 0–21 (a higher score indicates a higher level of anxiety)	6.0 [5.00–9.00] (2.00–16.00)
Case levels of anxiety: HADS-A score ≥ 11 [g]	6 (11)
Borderline cases: 8 ≤ HADS-A score ≥ 10	14 (26)
Non-cases: HADS-A score ≤ 7	34 (63)
Levels of depression, HADS-D score: 0–21 (a higher score indicates a higher level of depression)	4.00 [2.00–6.00] (3.00–23.00)
Case levels of depression: HADS-D score ≥ 11[g]	3 (6)
Borderline cases: 8 ≤ HADS-D score ≥ 10	6 (11)
Non-cases: HADS-D score ≤ 7	45 (83)
Pulmonary rehabilitation program	39 (65)

CAT COPD Assessment Test, *HADS-A* Hospital Anxiety and Depression Scale, anxiety subscale, *HADS-D* Hospital Anxiety and Depression Scale, depression subscale

Data are expressed as mean ± standard deviation, median [Q1—Q3] (minimum—maximum), or *n* (%)

[a]A cut-off value of 21 kg/m^2 was used, as survival decreases in patients with COPD and a body mass index ≤ 21 kg/m^2 [74, 75]

[b]Based on the 2008 Canadian Thoracic Society COPD Guidelines [30], disease severity was classified by symptoms and disability, as measured by the modified Medical Research Council dyspnea scale [76]. Provided that data on lung function (e.g., post-bronchodilator forced expiratory volume in 1 second [FEV_1] and forced vital capacity [FVC]) would have been available to us (which was not the case here), we would have also been able to classify individuals with a $FEV_1/FVC < 0.7$ according to their lung function impairment (GOLD stage 1–4), based on their value of

Table 1 (continued)

FEV_1, expressed as the percentage of the predicted value. Additionally and provided that data on the number of exacerbations in the past year would have been available to us (which was not the case here), we would have also been able to classify individuals according to their symptoms and risk of exacerbations, using the ABCD assessment tool [32]. These classifications would have followed international standards for the assessment of COPD, as reported in the 2018 GOLD report [32]

[c]Calculated according to the Canadian Thoracic Society Guidelines definition [77]

[d]Missing value: $n=3$ patients

[e]Cardiovascular disease included: coronary artery disease, arrhythmia, heart failure, cerebrovascular disease

[f]Based on the following item, quoted from the SLCDC: "Are your family or friends supportive when it comes to helping you manage problems related to your CODP if you need it?" Response options were either "yes" or "no"

[g]HADS scores were reported in categorical data based on the original cut-off points suggested by Zigmond and Snaith [48] and reported in Gibbons et al. [78]

CAT 95% CIs included the minimal clinically important difference of −4 [37] and −2 [38], respectively.

3.4.2 Health Resource Utilization

Before their first SMS session, about 25%, 29%, and 21% of patients with COPD, who met the trained educators, had one or more COPD-related unscheduled doctor visits, one or more emergency room visits, and one or more hospitalizations, respectively (Table 2). These adjusted percentages were not different before and after SMS (all p values> 0.05).

3.4.3 Proximal Outcomes of SMS

Changes in adjusted heiQ domain scores are displayed in Table 2. Adjusted mean heiQ Health-Directed Behaviour scores was 2.67/4.00 before SMS and 3.17/4.00 afterwards (MD: 0.50; 95% CI 0.23–0.77; $p=0.0005$). Meaningful improvements in adjusted scores were found because the observed standardized MD of 0.61 was higher than the expected standardized MD of 0.37 on the heiQ Health-Directed Behaviour domain [47]. Adjusted mean heiQ Skill and Technique Acquisition scores were 2.98 before SMS and increased by 0.12 units over time (95% CI 0.01–0.23; $p=0.0293$). Again, the observed standardized MD of 0.48 was higher than the expected standardized MD of 0.42 on the heiQ Skill and Technique Acquisition domain [47]. Changes from adjusted baseline scores on the six other heiQ domains were not statistically significant.

3.4.4 Sensitivity Analyses

We performed additional analyses to assess whether scores on the SGRQ-C, CAT, and heiQ were different between patients who participated in data collection before their first SMS session (as planned) and those who were reached over the phone only after having been exposed to SMS (Table 3). Although we found that baseline scores related to several heiQ domains were higher among the latter participants, differences were not statistically significant.

3.5 Educators' Perception of Organizational Support and Patient Outcomes Associated with SMS Provided

In interviews, educators reported strong organizational endorsement of their work (Table 4). Qualitative analyses revealed that managers, physicians, and other allied health professionals were all supportive of educators' SMS, although managers may not know what is happening during SMS. Educators also stated that they alone were responsible for delivering SMS. Even though they might be lacking time and resources, educators perceived that SMS resulted in decreased unscheduled doctor visits and hospitalizations in their practice. They also expressed that it helped patients to gain knowledge about COPD. Educators perceived that SMS provided benefits to patients with COPD, who quit smoking and appreciated being given time to express their needs. These results were considered as accurate by the participating educators in follow-up discussions.

4 Discussion

4.1 Key Findings

There is a paucity of studies measuring educational outcomes associated with CE activities for respiratory educators. Our study assessed patient outcomes associated with a 7-h lecture-based CE activity for respiratory educators based on the framework by Moore et al. [29]. Findings from our qualitative analyses suggested that, under real-life conditions, provision of information about COPD, training in inhalation techniques, and advice about smoking cessation

Table 2 Changes in patient outcomes[a] ($N=54$)

	Crude				Adjusted[b]				
	Before[c]	After	Change in scores		Before[c]	After	Change in scores		Residuals[d]
	Mean (95% CI)	Mean (95% CI)	MD (95% CI)	*p* value	Mean (95% CI)	Mean (95% CI)	MD (95% CI)	*p* value	*p* value
Quality of life									
SRGQ-C, Impact[e]	41.77 (35.08–48.45)	28.64 (22.63–34.65)	− 13.12 (− 18.83 to − 7.42)	< 0.0001	41.45 (36.06–46.83)	28.70 (23.49–33.90)	− 12.75 (− 18.79 to − 6.71)	0.0001	0.13
SRGQ-C, Activity[e]	71.88 (64.86–78.90)	62.46 (54.01–70.92)	− 9.42 (− 15.98 to − 2.85)	0.0059	73.30 (68.54–78.07)	65.11 (59.05–71.17)	− 8.19 (− 13.62 to − 2.76)	0.0040	0.26
CAT[f]	17.80 (15.73–19.87)	15.14 (12.92–17.36)	− 2.65 (− 4.24 to − 1.07)	0.0015	17.72 (15.93–19.52)	15.10 (13.24–16.96)	− 2.62 (− 4.25 to − 0.99)	0.0023	0.27
Proximal outcomes of SMS									
heiQ, Health-Directed Behaviors[g]	2.68 (2.45–2.92)	3.13 (2.94–3.33)	0.45 (0.19–0.71)	0.0012	2.67 (2.44–2.90)	3.17 (3.00–3.34)	0.50 (0.23–0.77)	0.0005	0.51
heiQ, Positive and Active Engagement in Life[g]	3.18 (3.07–3.30)	3.26 (3.16–3.36)	0.08 (− 0.05 to 0.21)	0.2301	3.03 (2.91–3.16)	3.10 (2.99–3.2)	0.07 (− 0.07 to 0.21)	0.3308	0.90
heiQ, Self-Monitoring and Insight[g]	3.18 (3.07–3.30)	3.26 (3.16–3.36)	0.08 (− 0.05 to 0.21)	0.2301	3.19 (3.08–3.30)	3.28 (3.17–3.38)	0.09 (− 0.05 to 0.22)	0.2120	0.41
heiQ, Constructive Attitudes and Approaches[g]	3.09 (2.94–3.24)	3.14 (3.03–3.24)	0.05 (− 0.09 to 0.19)	0.484	3.09 (2.98–3.27)	3.16 (3.06–3.20)	0.07 (− 0.08 to 0.22)	0.3303	0.24
heiQ, Skill and Technique Acquisition[g]	2.97 (2.89–3.05)	3.09 (3.00–3.17)	0.11 (− 0.014 to 0.21)	0.0268	2.98 (2.90–3.05)	3.10 (3.02–3.17)	0.12 (0.01–0.23)	0.0293	0.27
heiQ, Social Integration and Support[g]	3.28 (3.13–3.43)	3.24 (3.13–3.35)	− 0.04 (− 0.21 to 0.12)	0.6088	3.29 (3.17–3.42)	3.25 (3.14–3.35)	− 0.05 (− 0.22 to 0.12)	0.5689	0.16
heiQ, Health Services Navigation[g]	3.39 (3.26–3.52)	3.36 (3.24–3.48)	− 0.03 (− 0.18 to 0.11)	0.6679	3.41 (3.29–3.53)	3.37 (3.25–3.49)	− 0.04 (− 0.19 to 0.11)	0.5996	0.05
heiQ, Emotional Well-Being [g]	2.70 (2.48–2.91)	2.73 (2.60–2.86)	0.03 (− 0.15 to 0.22)	0.7326	2.70 (2.54–2.87)	2.73 (2.62–2.85)	0.03 (− 0.16 to 0.22)	0.7375	0.34
Health resource utilization in the preceding 6 months	Percentage (95% CI)	Percentage (95% CI)	PR (95% CI)	*p* value	Percentage (95% CI)	Percentage (95% CI)	PR (95% CI)	*p* value	Log pseudo-likelihood
≥ 1 COPD-related unscheduled doctor visits, %	26 (16–43)	17 (9–32)	0.64 (0.28–1.50)	0.2949	25 (15–43)	16 (8–31)	0.64 (0.27–1.53)	0.2961	413.38
≥ 1 COPD-related emergency room visits, %	28 (18–45)	19 (10–34)	0.66 (0.34–1.25)	0.1964	29 (18–46)	17 (9–32)	0.58 (0.29–1.14)	0.1045	391.96
≥ 1 COPD-related hospitalizations, %	23 (13–38)	18 (10–33)	0.82 (0.46–1.44)	0.4732	21 (12–37)	17 (9–32)	0.79 (0.41–1.52)	0.4728	457.43

BMI body mass index, *COPD* chronic obstructive pulmonary disease, *CAT* COPD Assessment Test, *CI* confidence interval, *HADS* Hospital Anxiety and Depression Scale, *heiQ* Health Education Impact Questionnaire, *MCID* minimal clinically important difference, *MD* mean difference, *mMRC* Medical Research Council dyspnea scale, *PR* prevalence ratio, *SGRQ-C* St. George's Respiratory Questionnaire, COPD-specific version, *SMS* self-management support

[a]These results are drawn from three-level hierarchical models that account for repeated measurements and educator clustering

[b]Models were adjusted for all confounders that resulted in a > 10% change in the differences in means or in proportion ratios, including: age (in years); sex (female/male); body mass index (< 21/≥ 21 kg/m^2); levels of anxiety and depression (cases/borderline/non-cases, as measured by the HADS); smoking history (≤ 41.25/> 41.25 packs/year); COPD stage (mild/moderate/severe, based on the mMRC grade); social support (yes/no); cardiovascular disease (yes/no), neoplasm (yes/no), metabolic disease (yes/no), respiratory tract infections in the preceding 6 months (yes/no), and/or exacerbations in the preceding 6 months (yes/no)

[c]Baseline data were collected soon after the first SMS session in 32/54 patients with COPD because educators delayed communicating patient information to the study coordinator (median time

Table 2 (continued)

delay between SMS and data collection: 26 days)

[d] We used the Shapiro–Wilk test to assess the normality of scaled residuals (generalized linear mixed models) and provided the associated *p* value. For generalized log-binomial mixed models, we herein present the residual log pseudo-likelihood as the fit statistic

[e] Score on any domain of the SGRQ-C ranges from 0 to 100; a lower score is indicative of a higher level of quality of life; MCID = 4

[f] Score on the CAT ranges from 0 to 40; a lower score is indicative of a higher level of quality of life; MCID = 2

[g] Score on any domain of the heiQ ranges from 1 to 4; a higher score is indicative of a more positive health education impact

could be consistently implemented by participating respiratory educators. In contrast, other SMS components such as regular follow-up visits were not implemented. Our quantitative findings highlighted that trained educators provided SMS that led to clinically important improvements in patient quality of life, health-directed behaviors, and skills and techniques in everyday practice. Health resource utilization remained unchanged. These findings led us to make the following four observations.

First, our results showed that respiratory educators, who attended the 7-h lecture-based CE activity on SMS, provided educational interventions that resulted in clinically important improvements in patient quality of life, particularly on the emotional domain, as others showed [58]. Our qualitative findings echoed our quantitative results, considering that educators reported, in interview, that patients appreciated being given time to express their needs. However, the observed effect of real-life SMS provided by a trained educator might have been overestimated. For instance, the participating respiratory educators had significant prior experience of care with patients and could have already been highly skilled in delivering SMS, similar to other educators who were considered as local champions elsewhere [26]. The participating respiratory educators also reported strong organizational commitment to their work, which is another factor associated with effective SMS implementation initiatives [59].

Second, our quantitative results showed that health resource utilization was not different over time, although our qualitative findings highlighted a positive effect of real-life SMS on emergency room visits and hospitalizations. On the one hand, the discrepancy between our qualitative and quantitative findings could be explained by our sample size, as we might have lacked statistical power to detect within-group changes in health resource utilization. On the other hand, our qualitative findings can also shed light on the reason why we did not find a statistically significant change in health resource utilization after SMS. Particularly, none of the participating educators reported implementing two or more follow-up visits in their practice, owing to limited time and human resources, although the importance of scheduling regular follow-up visits for patients with COPD had been underlined during the CE activity, in national guidelines [30], and in the international expert consensus report on COPD [14]. Providing regular follow-up as part of SMS has been shown to reduce COPD-related health resource utilization [26, 60, 61] and costs [62]. Our study showed, in contrast, that real-life SMS consisting of one to two visits may have an insufficient effect on self-management activities and, in turn, did not reduce health resource utilization.

In addition, to explain why trained educators provided SMS that did not result in decreased health resource utilization over time, another point to consider is a possible lack

Table 3 Baseline scores on the SGRQ-C, CAT, and heiQ: a sensitivity analysis

	All study participants ($N=54$) Mean ± SD	Participants whose data are collected before SMS, as planned ($n=22$) Mean ± SD	Participants whose data are collected soon after SMS ($n=32$) Mean ± SD	p value[a]
Quality of life				
SRGQ-C, Impact[b]	41.52 ± 22.77	41.50 ± 23.86	41.53 ± 22.39	0.996
SRGQ-C, Activity[b]	71.51 ± 25.36	67.67 ± 27.44	74.16 ± 23.92	0.36
CAT[c]	17.50 ± 7.38	17.23 ± 8.06	17.69 ± 7.00	0.82
Proximal outcomes of SMS				
heiQ, Health-Directed Behaviors[d]	2.69 ± 0.85	2.61 ± 0.96	2.74 ± 0.78	0.47
heiQ, Positive and Active Engagement in Life[d]	3.03 ± 0.50	2.93 ± 0.59	3.11 ± 0.42	0.30
heiQ, Self-Monitoring and Insight[d]	3.18 ± 0.41	3.22 ± 0.35	3.16 ± 0.45	0.10
heiQ, Constructive Attitudes and Approaches[d]	3.09 ± 0.54	2.92 ± 0.55	3.21 ± 0.50	0.06
heiQ, Skill and Technique Acquisition[d]	3.07 ± 0.37	3.05 ± 0.41	3.09 ± 0.34	0.63
heiQ, Social Integration and Support[d]	3.28 ± 0.55	3.19 ± 0.51	3.34 ± 0.57	0.36
heiQ, Health Services Navigation[d]	3.39 ± 0.46	3.40 ± 0.40	3.39 ± 0.51	0.92
heiQ, Emotional Well-Being[d]	2.71 ± 0.77	2.53 ± 0.87	2.83 ± 0.61	0.16

CAT COPD Assessment Test, *heiQ* Health Education Impact Questionnaire, *MCID* minimal clinically important difference, *SD* standard deviation; *SGRQ-C* St. George's Respiratory Questionnaire, COPD-specific version, *SMS* self-management support

[a]p values are derived from the Student t test

[b]Score on any domain of the SGRQ-C ranges from 0 to 100; a lower score is indicative of a higher level of quality of life; MCID = 4

[b]Score on the CAT ranges from 0 to 40; a lower score is indicative of a higher level of quality of life; MCID = 2

[c]Score on any domain of the heiQ ranges from 1 to 4; a higher score is indicative of a more positive health education impact

of competence in supporting patients: (1) to adhere to their prescribed treatments; (2) to demonstrate adequate inhalation techniques; or (3) to use the COPD action plan, as others have already highlighted [63, 64]. Educators are required to engage patients in their learning process, first by assessing patients' educational needs and by tailoring their intervention accordingly. In the present study, it remains unknown whether educators assessed each patient's educational needs at the beginning of the educational session, nor if they tailored the content of their session to these needs, as promoted during the CE activity. In this context, videotaping real-life SMS could help determine whether trained educators assess patients' learning needs in everyday practice. In addition, educators are not only required to communicate information or show the adequate inhalation technique to patients with COPD, educators are also required to ask patients to apply their knowledge and demonstrate their techniques during the SMS session. They should also provide patients with feedback on their understanding, skills, and techniques [21], as well as timely and easy access to advice or support, as in previous explanatory studies [26, 27]. As observational studies reported that real-life SMS could remain focused on provision of information [63, 64], in contrast to what SMS should be [21], there is a need for respiratory educators to learn how to increase patients' participation throughout the SMS session. In this regard, we believe that a CE activity employing active learning methods, especially role plays or simulations, could assist educators in developing such skills [28]. By participating in a SMS simulation, educators would be given the opportunity to apply their skills and reflect on their level of competence in delivering SMS for patients with COPD. Coupled with reflexive practice [65–67] and feedback from experienced respiratory educators [66, 68], such CE activity could further enhance professional practice and, in turn, patient outcomes, as we already hypothesized [28].

Third, our findings suggested that trained educators delivered real-life SMS that led to meaningful improvements in health-directed behaviors and the acquisition of skills and techniques over a 6-month period. Our qualitative results can help explain these findings because all educators reported: (1) delivering SMS that targeted both lifestyle advice (e.g., smoking cessation, a health behavior) and (2) teaching self-management activities (e.g., training in inhaler handling, a technique). In regard to skill and technique acquisition, we caution that we observed patient-reported improvements. In this present study, because healthcare utilization remained unchanged over time, further pragmatic studies should therefore focus on objective measures of inhaler and action plan use to ensure that these self-management activities are adequately implemented. Additionally, the absence of improvements in other domains of the heiQ may be because they were not targeted across all settings or because of a

Table 4 Summary of findings related to respiratory educators' perception of support from their organization and patient outcomes

Codes	Categories and illustrative quotations[a]
Organizational support	**Managers:** *Educator A* [My new manager thinks that] my work is outstanding … Soon it will be a year since we changed manager. The new manager is much more proactive than the previous one. However, she hasn't had a lot of time to come and see what I do, what my work involves and so on. Two or three weeks ago, she came and spent two days with me because she wants to implement educational services like the ones I provide [in another hospital] *Educator C* [My role as an educator with COPD patients] is very well thought of … I think that managers believe that these types of educational services must be implemented and implemented properly I think that my immediate superior knows very little about my role here with COPD clients. I think that it is a major deficiency in our team … I told my previous manager and my current manager, who started six months ago, that we really don't have enough support. Our manager doesn't know what we do … Teaching clients, I don't know how aware my manager is … She doesn't know how much time it takes us *Educator D* The feedback I get … has always been positive so far. There are patients who often used to come in for unscheduled visits with the doctor. Since they have come to see me, the doctor tells me: I don't know what you do with them but it works! The patient doesn't come back [to consult at the walk-in clinic] … They are able to manage their disease … A patient who had a chronic cough is able to control it now **Physicians and allied health professionals:** *Educator A* My colleagues in the emergency room refer more and more COPD patients they see in the emergency room to me. In pulmonology, respiratory therapists refer patients to me whenever they do tests that cause them to suspect COPD … Also, whenever respiratory therapists receive a request for a consultation in pulmonology for a COPD patient who is not doing very well, whose disease is not well controlled, despite their use of inhalers, respiratory therapists send them to see me before they see the pulmonologist *Educator B* The other day, I saw the doctor who refers patients to me … She had seen a client again whom I had met with and who was really satisfied with the meeting that I had with her … The doctor stopped me in the corridor to tell me and to congratulate me … My colleagues are satisfied too. For example, one of my colleagues referred a patient to me who had had a respiratory assessment and who had asked a lot of questions about her inhalers and about the disease. My colleague said to her: Would you be interested in seeing a respiratory therapist who could give you information about COPD? [My work as an educator] is well thought of because my colleagues don't always have the time, when they have a series of tests to do, to teach, to educate … My colleagues are happy to refer patients to me so that patients can get answers to their questions *Educator C* I am in a really privileged setting. Here, I think that we work a lot as a team with kinesiologists, nutritionists, nurses. We do quite a lot of health education **Availability of human resources:** *Educator A* I'm the only one who works [at the COPD clinic] I have someone who stands in for me from time to time when I have a vacation day or a day off But I'm really the only person who is here full time *Educator D* I'm always the only respiratory therapist with my patient
Patient outcomes	**Perceived benefits of SMS for patients with COPD:** *Educator A* The hospital's annual activities report was published recently and the report clearly says that the work that I do [with people who have COPD] has had an impact on hospitalizations and visits to the emergency room for COPD clients. We see the benefits for respiratory therapists' care plans on the hospital's wards. Not as many COPD patients are hospitalized as before … So it is clear that [educational interventions] have an impact The director of professional hospital services is very proactive and wants to develop the project in other places because the benefits are clear, the statistics support it and show that there was a real decrease in the number of emergency room visits … [These interventions] generate major savings for the hospital A high percentage of my clients stop smoking after seeing me *Educator D* The comment that patients make to me is that they have never had meetings with a health professional where they were given time to express their needs I have patients who come to see me … and who say to me: I have never understood my disease as well as I do with you

COPD chronic obstructive pulmonary disease, *SMS* self-management support

[a]Verbatim transcripts were edited for length and clarity

ceiling effect, considering that mean heiQ scores on several domains were higher than the benchmark baseline scores derived from an Australian sample of adults with chronic diseases [47]. Several other instruments could have been used to measure self-management, including the COPD Self-Management Scale, but none assessed responsiveness, nor could be recommended for use [69]. Further high-quality validation studies are needed for health researchers to select the best available instrument [69].

Finally, it is interesting to note that no educator reported negotiating with patients on the self-management plan, the learning objectives of the SMS program, or, maintaining their social and family life, the social activities that patients would like to be engaged in, as suggested by others [70]. This finding suggests that there could be a need to train educators in shared decision making by incorporating decision aids, which are known to foster shared decision making in other contexts [71], in an SMS simulation, for instance.

4.2 Strengths and Limitations

This convergent embedded mixed-methods study employed validated patient-reported outcome instruments to measure quantitative patient outcomes, and allowed us to contextualize patient outcomes associated with a lecture-based CE activity for respiratory educators, by providing important qualitative insights on real-life SMS for patients with COPD, as it is delivered in everyday practice. We nevertheless acknowledge the following limitations. First, educator recruitment remained challenging throughout the study and, consequently, data saturation could not be used as the criterion for stopping their recruitment, as others would recommend [72, 73]. Compared to non-participating educators, participating educators could have been more motivated to deliver self-management support for patients with COPD. They might also have been more experienced and felt more supported by their organization. As a result, (a) the generalizability of our qualitative findings in regard to SMS description might be diminished and (b) our quantitative patient outcomes might have been overestimated.

Second, because educator recruitment remained challenging, it was difficult, in turn, to reach our patient recruitment target. We therefore lacked statistical power while conducting our quantitative analyses, particularly in regard to health resource utilization. Third, research assistants retrospectively collected baseline data in more than half of the recruited patients with COPD because educators delayed communicating patient information to the study coordinator. The resulting measurement bias may have led to an underestimation of the effect of self-management support on proximal outcomes of SMS. This could also explain why, in this present study, baseline scores on several domains of the heiQ were higher than the benchmark scores [47]. Fourth, improvements in patient outcomes might have been underestimated because educators provided SMS 4 months having attended the CE activity and may have forgotten some of the concepts presented meanwhile. However, our results reflect a real-life effect.

Finally, some SMS programs were coupled with pulmonary rehabilitation, which could have contributed to overestimate the effect of SMS on quality of life. However, we lacked statistical power to perform additional sub-group analyses. Notwithstanding these limitations, our study provides important insights into what could be the best training program for respiratory educators and points towards the importance of integrating new active leaning activities during the CE activity. In this regard, there is a need to compare the observed patient outcome with those estimated within a group of patients who would have met untrained educators or educators who would have attended a CE activity comprising another form of learning activity than a lecture.

4.3 Generalizability

Our findings inform about the delivery and patient outcomes of COPD-specific SMS programs delivered in everyday practice by motivated and strongly supported respiratory educators who had significant prior professional experience of care with patients with chronic disease and who attended a lecture-based CE activity on SMS.

5 Conclusions

Our results showed that educators with significant prior professional experience of care with patients with chronic disease, including patients with COPD, and who participated in a 7-h lecture on SMS provided, after the CE activity, COPD-specific SMS that included provision of evidence-based information, self-management training, and lifestyle advice. In turn, SMS resulted in improved patient quality of life, health-directed behavior, and skill and technique acquisition. Organizational commitment to these interventions was strong, but a lack of personnel delivering SMS within settings may limit improvements, especially in regard to health resource utilization. Employing active learning methods could help educators to assist patients with COPD in learning how to implement self-management activities and, in turn, could also contribute to reduce health resource utilization.

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Author Contributions MG, SL, CH, JB, JM, and LPB contributed to the study design. MG, JBT, and SEP participated in participant recruitment and/or data collection. MG conducted statistical analyses and participated, along with CH, to qualitative analyses. All authors contributed to data interpretation. M.G. wrote the initial draft and SL, CH, JBT, SEP, JB, JM, and LPB revised it for important intellectual content. All authors have given final approval of the version to be published. MG and LPB have full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Data Availability All quantitative data analyzed during this study in this article are provided as Electronic Supplementary Materials. Audiovisual datasets analyzed during the current study are not publicly available because of confidentially issues.

Compliance with Ethical Standards

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Informed consent Informed consent was obtained from all participants included in the study.

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