Disease-specific health education for COPD: a systematic review of changes in health outcomes

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Abstract

A systematic review was conducted to determine the benefits of disease-specific health education for people with chronic obstructive pulmonary disease (COPD). A search was conducted through Medline, CINAHL, PsycINFO, Embase, Cochrane Library, Physiotherapy Evidence Database and reference lists to obtain publications reporting on educational interventions compared with usual medical care. Two reviewers independently assessed each paper for methodological quality and data extraction. Thirteen publications describing 10 randomized controlled trials were identified for inclusion. The studies reported on a very broad variety of outcomes and follow-up periods, making a meta-analysis not possible for most measures. Didactical educational intervention for the COPD population appeared to have minimal effect on health outcomes including quality of life, health care utilization, exercise capacity or lung function and is therefore not the education delivery method recommended. Education focusing on self-management showed encouraging results with a tendency for improvements in quality of life and health care utilization, but the results did not reach statistical significance as sample sizes were insufficient to detect an effect. Further research is required into self-management education as it is not possible to make generalizations from the current published literature as to the benefits in changing health status in the COPD population.

Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic lung condition which predominantly develops from long-term exposure to cigarette smoking, resulting in irreversible dilation and destruction of lung parenchyma [1]. COPD leads to persistent symptoms of breathlessness, limiting the patients’ ability to perform daily tasks and function within society. Management of people with COPD aims to optimize function, prevent deterioration and maximize quality of life [2]. Pharmacotherapy has traditionally been the method of management. However, the irreversible nature of the condition usually means that despite optimal pharmacological treatment, patients often experience substantial functional impairments as they lead a sedentary lifestyle to avoid any feelings of breathlessness, which in turn causes a decrease in exercise capacity [1]. They also have a tendency to develop complications such as recurrent respiratory infections and psychosocial and behavioral issues which results in a large disease burden for both the individual and community. COPD is the fourth leading cause of death in the United States [3] and the economic costs in the United States surpassed $18 billion direct costs in 2002 [4]. The prevalence, morbidity and mortality are expected to rise with the rapidly aging population, even in populations where smoking rates are declining [5]. It is estimated that by

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2020, COPD will rank fifth among the conditions with the highest burden to society on a worldwide scale [6]. This will result in an ever-increasing pressure on the health care system. Consequently, there is a growing need for enhanced management of patients with COPD, not only to prevent deterioration of lung function but also to improve the patient’s ability to function within society despite their impairments and avoid some of the aforementioned complications associated with the disease.

Educational interventions for chronic illnesses aim to provide patients with the knowledge and skills to deal with limitations imposed by the disease. Education programs for asthma, in particular self-management education, have been shown to be an effective means of improving health outcomes including health care utilization, days lost from work and quality of life [7]. Education is now a key recommendation in asthma management guidelines [8]. As asthma is a chronic lung condition, the improvements in health outcomes noted in this population following educational activities may also be obtainable in the general COPD population. Several trials have now been conducted assessing the benefits of educational programs for the general COPD population. This systematic review is designed to examine the changes in quality of life, functional status, self-efficacy, psychological function and health care utilization reported by those trials comparing disease-specific patient education and usual medical care for patients with COPD.

**Methods**

**Search protocol**

Data bases, including Medline (1966–June 2005), CINAHL (1982–June 2005), Embase (1988–June 2005), PsychINFO (1872–June 2005), the Physiotherapy Evidence Database (PEDro) Library and the Cochrane Library were searched for peer-reviewed publications using the following terms: chronic lung disease—obstructive, education or self-management and quality of life or health care utilization or function (including exercise tolerance or pulmonary function) or self-efficacy. Due to resource limits, studies reported on in a language other than English were screened from the search. For all articles obtained in full text, the reference lists were also checked for additional papers.

**Selection of the literature**

Two independent reviewers examined the abstracts for inclusion. Studies were included if they were randomized or clinical controlled trials assessing the impact of education on quality of life and health care utilization in the COPD population. We excluded studies where participants did not have a primary diagnosis of COPD as classified by National Heart, Lung and Blood Institute/World Health Organization Global Initiative for COPD [a forced expiratory volume (FEV1) of <80% predicted and a FEV1/forced vital capacity (FVC) ratio of <70%] [9], included other chronic diseases in the sample (including asthma), where the education was not disease specific to the COPD population, where exercise was also included as an intervention or where the control group did not receive usual medical care. Only studies examining any one of the following outcomes were included: quality of life or self-efficacy, functional status or health care utilization, including physician consultation frequency, pharmaceutical usage, hospitalization, emergency visit or length of stay, as measured by reliable and valid outcomes for the COPD population. Finally, studies reported through abstracts of conference proceedings were not included in the review as insufficient details on methodology and results were reported on for this review.

For the purpose of this review, patient education was defined as formal delivery of education on topics related to COPD with the aim to improve the knowledge and understanding of COPD. The patient education was then categorized into self-management education and didactical education and group or individually tailored. Self-management education was defined as education focusing on changing health behaviors through knowledge, goal setting and development of action plans [10]. Didactical education was considered to be where participants received education in a passive lecture format, with opportunity to interact, but no
focus on health behavior change. Any health professional could deliver the education and it needed to involve at least one occasion where the participant or group of participants had face-to-face interaction with the health professional. Education which was delivered in the written or video format in isolation was not considered for this review as these modes result in a very different interaction and learning environment and will therefore potentially result in different outcomes. Education which was not delivered in a formal manner was considered to be usual care as many health professionals deliver education to patients informally as advice to improve compliance with treatment.

**Data extraction and analysis**

The data extraction and quality assessment of the studies were completed by two independent reviewers (KEW and FB). Agreement was examined and any disagreement resolved through discussion and consensus. The methodological quality of the studies was reviewed using the PEDro scale, developed by the School of Physiotherapy, University of Sydney (1999) [11]. The scale required minor modification, with removal of the criteria blinding of therapist and blinding of participant. This was done as it is not possible to blind the health professional delivering education or the individual receiving the education in behavioral clinical trials. The original criteria reviewing dropout rate requires a rate of <15% and this is not attainable in the COPD population. Traditionally, this population has a higher dropout rate due to exacerbations of their disease and it is unreasonable to expect >85% of participants complete a program. To ensure studies were not penalized for having a dropout rate between 80 and 85%, the criterion was modified to state ‘measures of at least one key outcome were obtained for greater than 80% of the subjects allocated to groups’. All other criteria and guidelines to the PEDro scale were used unmodified and therefore the total possible score for the modified PEDro scale used in this review was 8, with a higher score indicating better methodological quality. Data extraction was completed using a standardized spreadsheet developed for this review. Due to the large variability in outcomes used by each of the studies, a meta-analysis for all outcomes could not be performed, however where possible summary analyses have been performed.

**Results**

The search identified a total of 556 titles and abstracts. The full-text version of 53 publications was obtained for further consideration by the reviewers. No additional publications were found in the reference lists. The two reviewers outright agreed on inclusion and exclusion for all but six papers. A unanimous decision was made following a short period of discussion for the final six papers; a third reviewer was not required for consultation. One publication authored by Gallefoss [12] was found through the search process, however the data reported in this publication were the same as that reported in previous publications [13–16] and therefore the paper was not considered for the review. A total of 13 publications were included in the review [13–25].

**Quality assessment of studies**

Table I gives a summary of the quality of the studies included in the review. The study methodology was of reasonable quality with 50% of the studies obtaining a score of ≥6 out of 8 [13–18, 21, 22, 25]. The lowest score obtained and therefore the poorest methodological quality was Howland et al. [20], with a score of 3. No studies were excluded based on quality as the criteria of the scale were not weighted.

**Study characteristics**

Characteristics of each study are summarized in Table II. As can be noted, all studies published by Gallefoss [13–16] had the same sample characteristics. Contact was made with the author to discuss the publications and it was confirmed that one sample was obtained, underwent the intervention and the different outcome measures were then described in each of the publications. A total of 659 participants with COPD have undergone education across all the studies, with results being compared with 744 participants receiving usual care, with an
equal contribution of male and female participants (53 and 47%, respectively). The average mean age across all studies was 64.8 ± 8.5 years in the education groups and 64.8 ± 8.7 years in the control. All studies reporting FEV₁% predicted had a mean below 60% [13–16, 18, 22–25], indicating moderate to severe COPD [9].

Table III summarizes the education delivery mode. Six of the studies conducted education on an individual basis [17, 19, 22–25], three in group settings [18, 20, 21] and four publications (published by Gallefoss) used a combination of group and individual [13–16]. Nine of the studies were considered to be self-management education [13–17, 21–23, 25], with the remaining four studies being didactical in nature [18–20, 24]. Table IV summarizes the education topics covered by each of the studies.

**Outcomes**

A total of 40 different outcome measures were reported on across the 13 different publications, with many only having one study examining the outcome. Table V summarizes the key findings across all the studies.

**Health care utilization**

Health care utilization was examined in some form by seven studies [13, 14, 17, 22–25]. Two studies reported the mean number of total general practitioner (GP) visits over the 12-month period following study inclusion [14, 25]. Meta-analysis of the difference in mean number of total GP visits in these studies showed that the control group attended 0.53 visits more than the education group (−0.7 to 1.75 95% CI), which was not statistically significant. Although, significantly more participants in the control group attended their GP greater than once in a 12-month period (26% of education group and 84% of control group, \(P < 0.0001\)) [14].

The cost associated with GP visits in the 12 months following intervention was significantly less in the education group in two studies [13, 24]. A mean decrease of DKK89 in the education group and a mean increase in GP costs of DKK1346 (Danish Krone) in the control (\(P = 0.001\)) were reported by Tougaard et al. [24], and a mean GP cost of NOK100 (29–170 95% CI) (Norway Krone) in the education group and NOK 900 (407–1393 95% CI) in the control group (\(P < 0.001\)) reported by Gallefoss and Bakke [13]. These results were not pooled into a meta-analysis, as one study reported on mean increase or decrease in cost while the other reported on mean total cost for each group.

The number of total hospital bed days over the 12 months following education was examined by two studies [14, 17]. When combined, the results...
showed had a mean difference in total hospital days of 3.0 (−0.49 to 6.5 95% CI), with the education group having less hospital days, which was found to be not significant.

Three studies assessed the percentage of participants requiring one or more admissions to hospital, and the combined results showed that COPD patients are 2.3 times (1.5–3.5 95% CI) more likely to require one or more hospital admissions in 12 months without education, and only five (4–11 95% CI) patients need to receive education to prevent one hospital admission in 12 months [17, 23, 24].

Antibiotic usage was assessed in three studies [22, 23, 25]. Watson et al. [25] analyzed the days on antibiotics as a percentage of the days with symptoms recorded in a symptom diary. The education group spent 10% of days with symptoms on antibiotics while the control group spent only 4% (P = 0.016). The other two studies reported the percentage of participants requiring antibiotics in the 12-month follow-up to be 58% in the education and 69% in the control [23] and 79% in the education and 52% in the control [22]. The difference for Littlejohns et al. [22] was statistically significant; however, when the results of the two studies [22, 23] were combined and analyzed, the result illustrated only a 1.4 times (0.9–2.5 95% CI) greater likelihood for patients receiving education to be taking antibiotics, which was not statistically significant.

The percentage of patients requiring a course of oral steroids was examined by three studies [16, 22, 23]. Gallefoss and Bakke [16] found 69% of those who received education compared with 44% of those in the control group required a course of oral steroids. Littlejohns et al. [22] reported steroid rate of 49% in the education group and 37% in the control group, while Rea et al. [23] reported 48% of the education group and 50% of the control group. None of these results were statistically significant. When combined for analysis, the results illustrated a 1.4 times (0.9–2.3 95% CI) greater likelihood of requiring an oral steroid course when receiving education, which was not statistically significant.

Health care costs across all areas other than GP visits, including hospital care, physician visits, pharmaceutical usage and total direct health care cost were not found to be statistically significant between the groups during the 12 months following intervention [13, 24]. However, a tendency for greater usage was noted in the control group. A cost-benefit analysis was completed by Gallefoss and Bakke [13] which showed that for each NOK spent on education delivery, a saving of 4.8NOK in health care utilization was achieved.

### Health-related quality of life

Health-related quality of life (HRQoL) was measured in eight of the studies, however a wide variety of measures were used.

COPD-specific HRQoL was measured by the St George Respiratory Questionnaire (StGRQ) in three studies [15, 17, 25]. Following intervention, Bourbeau [17] noted a statistically significant difference between the education and control groups in change of total score on the StGRQ between baseline and post-intervention with the education group showing greater improvement [17]. Watson et al. [25] did not support this, finding no statistically significant difference in the mean of the total score post-intervention. However, they did note a tendency for the education group to have a better quality of life score. The significant difference noted by Bourbeau [17] was no longer significant at the 12-month time period (treatment difference of 2.0, 5.9 to 1.8 95% CI). Gallefoss et al. [15] examined mean total scores 12 months post-intervention only, and found a tendency for the education group to have a better quality of life, however again this was not statistically significant. Measures were taken at different time points following intervention and change scores versus mean scores were reported by the different studies making a meta-analysis not possible.

Rea et al. [23] assessed disease-specific HRQoL using the Chronic Respiratory Questionnaire. They noted a statistically significant difference between the mean change scores for the fatigue (P = 0.01) and mastery (P = 0.007) domains indicating the education group had an improvement in HRQoL in these domains, but not in
| Study                  | Sample size | Age (years) | Sex | FEV₁ (% predicted) | Follow-up (months) | Outcomes                                                                 |
|-----------------------|-------------|-------------|-----|--------------------|--------------------|---------------------------------------------------------------------------|
| Bourbeau [17]         | 96 95       | 69.4 ± 6.5  | 69.6 ± 7.4 | 106 85             | 0.33a 0.31a         | 4 and 12                                                                  |
| Emery et al. [18]     | 24 25       | 67.4 ± 5.9  | 67.4 ± 7.1 | 22 27              | 43b 39b            | 2                                                                         |
| Gallefoss et al. [15] | 31 31       | 57 ± 9      | 58 ± 10    | 31 31              | 59 ± 9             | 56 ± 11 12                                                               |
| Gallefoss and Bakke [16]| 31 31       | 57 ± 9      | 58 ± 10    | 31 31              | 59 ± 9             | 56 ± 11 12                                                               |
| Gallefoss and Bakke [14]| 31 31       | 57 ± 9      | 58 ± 10    | 31 31              | 59 ± 9             | 56 ± 11 12                                                               |
| Gallefoss and Bakke [13]| 31 31       | 57 ± 9      | 58 ± 10    | 31 31              | 59 ± 9             | 56 ± 11 12                                                               |
| Gourley et al. [19]   | 43 54       | N N N N N N | 1           |                    |                    |                                                                           |
| Howland et al. [20]   | 213 325     | 59b 60b     | 253 257    | N N                | 1                  |                                                                           |
| Kara and Asti [21]    | 30 30       | 61 ± 11.3   | 61 ± 11.1  | 47 13              | N N                | 1                                                                         |
| Littlejohns et al. [22]| 68 65       | 62.9 ± 7.8  | 62.5 ± 7.6 | 87 46              | 45 ± 22 50 ± 23     | 12                                                                        |

- 6-min walk test
- Number of exacerbations
- Hospital admissions and LOS
- Emergency department presentations
- GP visits (scheduled versus unscheduled)
- Respiratory physician visits (scheduled versus unscheduled)
- StGRQ
- VO₂ maximum
- SIP
- State-Trait Anxiety Inventory
- The Centre for Epidemiological Studies—Depression Inventory
- Cognitive function
- StGRQ
- Self-designed HRQoL measure
- Steroid inhaler usage
- Oral steroid usage
- Rescue bronchodilator usage
- GP visits
- Hospital bed days
- Days off work, % taking time off work and at work at conclusion of study
- GP, respiratory physician, hospital admission, production loss and pharmaceutical costs
- Cost-benefit analysis
- HSQ
- Self-designed knowledge questionnaire
- Zung Anxiety Scale
- Zung Depression Scale
- SIP
- COPD-SES
- FEV₁, SaO₂ at rest and exertion
- 6-min walk test and step test
- Anxiety and depression score
| Study               | Sample size | Age (years) | Sex | FEV₁ (% predicted) | Follow-up (months) | Outcomes                                                                 |
|---------------------|-------------|-------------|-----|-------------------|-------------------|--------------------------------------------------------------------------|
| Rea et al. [23]     | 83          | 52          | 68  | 56                | 12                | Hospital admissions and LOS FEV₁ and Shuttle walk test CRQ SF-36         |
|                     |             |             |     | 79                |                   | Medication prescription diaries PaO₂, FEV₁ and FVC                      |
|                     |             |             |     | 52                |                   | Length of stay for education                                           |
|                     |             |             |     | 50                |                   | Pharmaceutical costs                                                    |
|                     |             |             |     |                   |                   | Total health care costs                                                 |
|                     |             |             |     |                   |                   | Hospital readmissions                                                   |
|                     |             |             |     |                   |                   | Patients requiring mechanical ventilation on readmission (%)           |
|                     |             |             |     |                   |                   | GP visit costs                                                          |
|                     |             |             |     |                   |                   | Courses of antibiotics and steroids Symptom diaries                     |
| Tougaard et al. [24] | 42          | 40          | 70  | 67                | 12                | Hospital readmissions                                                   |
|                     |             |             | 8.7 |                   |                   | Patients requiring mechanical ventilation on readmission (%)           |
|                     |             |             |     |                   |                   | GP visit costs                                                          |
|                     |             |             |     |                   |                   | Courses of antibiotics and steroids Symptom diaries                     |
| Watson et al. [25]  | 29          | 27          | 68  | 36                | 6                 | Hospital readmissions                                                   |
|                     |             |             | 10  | 20                |                   | Patients requiring mechanical ventilation on readmission (%)           |
|                     |             |             | 67  | 37                |                   | GP visit costs                                                          |
|                     |             |             | 8   |                   |                   | Courses of antibiotics and steroids Symptom diaries                     |

Int = intervention group and Con = control group, N = not supplied, LOS = length of stay for hospital admission, SIP = Sickness Impact Profile, HSQ = Health Status Questionnaire 2.0, CRQ = Chronic Respiratory Questionnaire, SF-36 = Short Form-36.

*FEV₁ not given as % predicted, given in liters ± SD. **No SD given. †Mean age of both groups. No standard deviations given. Age range of 44–84.
the dyspnea ($P = 0.99$) or emotional ($P = 0.15$) domains.

General HRQoL was measured with the Sickness Impact Profile, the Short Form-36 and Health Status Questionnaire 2.0 across five studies [18–20, 22, 23]. All studies did not find any significant difference in scores between the groups across all domains [18–20, 22, 23].

### Pulmonary function and exercise tolerance

No study found a significant difference in exercise tolerance following education as measured by VO$_2$ maximum, the 6-min walk test, the step test and the shuttle walk test [17, 18, 22, 23].

Two studies examined pulmonary function; Rea et al. [23] showed a significant decline in mean

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#### Table III. Summary of educational delivery mode, length of education and health professionals delivering education

| Study                    | Education style | Venue   | Length of education                                      | Professionals delivering education                      |
|--------------------------|-----------------|---------|----------------------------------------------------------|--------------------------------------------------------|
| Bourbeau [17]            | Individual      | Home    | 1 h per week                                             | Nurses                                                 |
|                          | Self-management |         | 7–8 weeks                                               | Respiratory therapist                                  |
|                          |                 |         |                                                         | Physiotherapist                                         |
| Emery et al. [18]        | Group           | O/P     | 1 h sessions                                             | Clinical Psychologist, and others not stated           |
|                          | Didactical      |         | 10 weeks (total of 16 sessions on education and 10 on    |                                                        |
|                          |                 |         | stress management)                                       |                                                        |
| Gallefoss et al. [15],   | Group and       | O/P     | Two 2-h group sessions on two separate days             | Medical Doctor                                         |
| Gallefoss and Bakke [16],| individual     |         |                                                          | Pharmacist                                             |
| Gallefoss and Bakke [14],| Self-management |         | Then one to two individual with nurse and one to two    | Nurse                                                  |
| Gallefoss and Bakke [13] |                 |         | individual with physiotherapist                          | Physiotherapist                                         |
| Gourley et al. [19]      | Individual      | O/P     | A series of five scheduled visits, every 4–6 weeks      | Pharmacists                                            |
|                          | Didactical      |         |                                                         |                                                        |
| Howland et al. [20]      | Group           | O/P     | Two education programs                                   | Not stated                                              |
|                          | Didactical      |         | Severe disease = six 2-h sessions                        |                                                        |
|                          |                 |         | Mild disease = three 2-h sessions                        |                                                        |
| Kara and Asti [21]       | Group           | O/P     | 4 weeks                                                 | Nurses and others not stated                           |
|                          | Self-management |         | Three to four session per week of 35–40 min             |                                                        |
| Littlejohns et al. [22]  | Individual      | Home    | Over a 12-month period. No details on frequency of      | Respiratory health care worker (nurse)                 |
|                          | Self-management |         | contact with respiratory health care worker             |                                                        |
| Rea et al. [23]          | Individual      | O/P and | Monthly meetings with the nurse and three monthly       | Respiratory nurse                                       |
|                          | Self-management | Home    | meetings with the GP. One home visit from the           | Practice nurse                                          |
|                          |                 |         | respiratory nurse (and another following an inpatient   | Respiratory physician                                  |
|                          |                 |         | stay)                                                   | GP                                                     |
| Tougaard et al. [24]     | Individual      | I/P     | Education delivered while IP.                          | Nurse                                                  |
|                          | Didactical      |         | Mean of 258 min of education time                       | Doctor                                                 |
| Watson et al. [25]       | Individual      | O/P     | Less than 60 min with the practice nurse or GP (40%    | Practice nurse                                          |
|                          | Self-management |         | spending 10–20 min, 35% spending 20–30 min). Time      | GP                                                     |
|                          |                 |         | then spend reading information from booklet             |                                                        |

O/P = outpatient clinic setting, I/P = inpatient clinical setting.
FEV₁% predicted in the control group: intervention mean of 53.9% and control mean of 45.6% (P < 0.001). This was not supported by Littlejohns et al. [22] who demonstrated non-significant difference in FEV₁% predicted change: intervention mean change –2.06 and control mean change of –0.15.

**Psychological status**

The study of Kara and Asti [21] is the first to report on the effects of education on self-efficacy. Using the disease-specific COPD Self-Efficacy Scale (COPD-SES), they found a statistically significant within-group improvement in self-efficacy with all the participants. However, the between-group differences were not significant with the mean COPD-SES total score for the education group and control group 1 month following intervention being 3.58 (3.1–4.06 95% CI) and 2.8 (2.26–3.14 95% CI), respectively.

Other outcomes which were assessed by individual studies included days lost to work, production loss costs, cognitive function, depression, anxiety and knowledge. No significant difference was noted between the education and control groups on these measures [14,18–20, 22].

**Discussion**

This review has analyzed the outcomes from 13 publications, incorporating 10 randomized controlled trials examining disease-specific education with usual medical care. Education appears to improve health care utilization in the COPD population, as significantly fewer patients with COPD were admitted to hospital more than once in 12 months following education and those not receiving education were 2.3 times more likely to require a hospital admission. Also, there were significant decreases in the costs associated with GP visits. The studies reporting on these findings all examined self-management education. This review does not examine the reasons why COPD patients receiving education showed decreases in health care usage, but a possible explanation is that patients receiving...
Table V. Summary of key outcomes following intervention

| Outcome                          | Results of different measures                                                                                                                                                                                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GP visits                        | • Gallefoss and Bakke [14] examined mean total number of GP visits and found significantly less visits in the education group compared with usual care [0.5 visits (0.2–0.8 95% CI) and 3.4 visits (1.4–5.3 95% CI), respectively]. Watson et al. [25] showed a non-significant increase in mean total visits in the education group [25] compared with usual care [three visits (1.9–4.1 95% CI) and two visits (0.9–3.1 95% CI), respectively]. Meta-analysis showed no significant difference in GP visits.  
  • Significantly more unscheduled GP visits in the usual care group compared education (112 versus 46 respectively, \( P = 0.003 \)) [17].  
  • No education results in 15.6 times more likely to visit a GP >1 in a 12-month period (4.0–61 95% CI) [14]. |
| Physician visits                 |                                                                                          | No significant difference in total number of visits >12 months [17]. |
| Number of exacerbations          | • No significant difference in the total number of exacerbations in the education group versus usual care (299 versus 362 respectively, \( P = 0.06 \)).  
  • Number of exacerbations requiring hospital admission significantly greater in usual care group compared with education (161 versus 95 respectively, \( P = 0.02 \)) [17].                                                                 | |
| Hospital admissions              | • No significant difference in total number of hospital admissions over the 12 months [17].  
  • Tougaard et al. [24] reported 17% of participants who received education and 35% of participants in the control group (\( P = 0.057 \)) required at least one hospital admission.  
  • Rea et al. [23] reported 22 and 39%, respectively (\( P > 0.05 \)) and Bourbeau et al. [17] reported 33 and 50%, respectively (\( P = 0.01 \)). Control group 2.3 times more likely of being admitted to hospital or one more occasions [17, 23, 24].  
  • Only five patients to receive education to avoid one person being admitted each 12 months.                                                                                       | |
| Hospital bed days                | • Gallefoss et al. [14] found a difference in total hospital days of 1.8 days (−2.2 to 5.8 95% CI) while Bourbeau et al. [17] found a mean difference in total hospital days of 5.3 days (−12.1 to 22.7 95% CI). Meta-analysis showed control group spent a mean of 3.0 days more in hospital >12 months (6.8 to −0.5 95% CI) but not statistically significant [14, 17].  
  • Hospital days for respiratory condition was found to be significantly less in the education group compared with usual care (1.1 versus 4.0 respectively, \( P = 0.03 \)) [23].                                                                 | |
| Use of antibiotics               | • A total of 1.4 times more likely to take antibiotics in the education group, but not statistically significant [22, 23].                                                                                                       | |
| Use of oral steroids             | • No significant difference in defined daily dosages (DDD)* of ‘rescue oral steroids’ between control and intervention  
  for oral steroids (100 versus 125, \( P = 0.21 \)) [16]. Significantly more oral steroid dispensed to the education group compared with control (median DDD 200 versus 100, \( P = 0.02 \)) [16].  
  • A total of 1.44 times more likely to take oral steroids in the education group, but not significant [16, 22, 23].                                                                 | |
| Rescue beta\(_2\) agonist        | • The median DDD of the education group for rescue short acting beta\(_2\) agonists was 125 as compared with 290 in the control group (\( P = 0.03 \), equating to twice as many daily dosages of rescue medication being required by those without education [16].                                                                 | |
| Health care costs                | • Significant increases in GP costs for the control group [13, 24]. However, all other costs were not significantly different between the groups [13, 24].                                                                                                          | |
| Disease-specific HRQoL           | • StGRQ: Total score: Post-intervention, clinically and statistically difference in change of total score with the education group showing a better HRQoL (4.2, 0.7–7.7 95% CI) [17]. However not supported by Watson et al. [25], no significant difference in mean total score for education group (mean difference between groups of 4, −4.4 to 12.4 95% CI). Group difference not maintained 12 months following intervention, although tendency for better HRQoL in education group [15, 17].  
  • CRQ: Significant improvement for intervention in fatigue and mastery [23]. Clinically significant between-group difference for intervention group in all domains [23].                                                                  | |

\*DDD: Defined daily dosages
self-management education may have a greater self-efficacy to manage exacerbations without medical attention. Self-efficacy expectations have been found to predict survival [26] and functional performance [27], and influence quality of life in patients with COPD [28]. However only one study, Kara and Asti [21] has examined self-efficacy following education and they did not find any significant difference between the groups on COPD-SES scores as both groups improved during the intervention phase. They also did not examine any other outcomes to compare the changes in self-efficacy scores with changes in HRQoL, functional measures and health care utilization. As this is the first study to look at self-efficacy, the effects of education on self-efficacy with relation to other health outcomes have not yet been fully examined.

GP visits found conflicting results across the two studies that examined total visits in a 12-month period. Gallefoss and Bakke [14] found significantly more visits by the control group, while Watson et al. [25] found no significant difference between the groups with a tendency for increased visits in the education group. A possible explanation for this difference is that the education group was purposefully scheduling regular checkups with their GP to monitor their health status. Neither study separated scheduled visits from non-scheduled visits. Bourbeau [17], who examined scheduled versus unscheduled visits, found a tendency for the education group to have more scheduled visits than the control group.

A tendency for non-significant decreases in health care utilization was also noted in the education group across the other variables being pharmaceutical usage, health care costs and hospital admissions. With a prevalence rate of >16 million North Americans, the reported direct cost of COPD is >$18 billion annually in the United States alone [4]. A difference in health care usage of >10% could mean a saving of >$1.8 billion per annum in the United States. Educational intervention across three studies showed a decrease of up to five hospital days per annum following intervention. This equates to a difference of 30% in length of stay. As the results were not statistically significant in two of the studies despite both studies being considered to be of high methodological quality (>6/8 on the modified PEDro scale), a post hoc power analysis was completed for the between-group differences. For the small effect size, Gallefoss and Bakke [14] required a sample of 514 and Bourbeau [17] required a sample size of 368 to have 80% power at an alpha of 0.05. Therefore, it is possible that significant differences would have been noted if the sample size was larger. Also, when looking at the non-significant findings of costs associated with other areas of health care utilization reported by Gallefoss and Bakke [13], mean costs across all areas were >10% higher in the control group. Again, sample

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**Table V. Continued**

| Outcome | Results of different measures |
|---------|--------------------------------|
| Pulmonary function and exercise tolerance | - FEV₁ % predicted: Significant deterioration in control in one study [23], second study found no significant difference between results [22].
- Arterial oxygenation at rest and exertion: No significant difference between groups [22, 24].
- Exercise tolerance: No significant difference between the groups regardless of outcome measure [17, 18, 22, 23]. |
| COPD symptoms | - No significant difference in reported symptoms in diaries [25]. |
| Psychological status | - No significant difference in anxiety or depression [18, 20, 22].
- No significant between-group difference in self-efficacy, but tendency for greater improvements in the education group [21].
- No significant difference between groups in cognitive testing following intervention [18]. |

CRQ = Chronic Respiratory Questionnaire.
sizes were too small to have power >80% for those areas that did not reach significance. To be confident to state that health care utilization usage and costs were not different between those receiving education with those receiving usual medical care, studies involving larger sample sizes are required.

Only one study [13] has examined cost of program versus cost savings with health care and found that for everyone one NOK spent on education, a saving of 4.8NOK was made. This is supportive of education programs; however as only one study has examined such findings, the results can only be extrapolated for that particular model of education.

The significant decreased usage of rescue medication by those receiving education [16] may suggest that education leads to a better disease management by the individual with COPD as symptoms are controlled rather than relieved. This is supported by the tendency of increase in dispensing of oral steroids and antibiotics [16, 22, 23, 25] and significantly less unscheduled visits to a GP for those who received education [17]. Rather than allowing the condition to deteriorate and require medical attention, it would appear that patients who have received education fill prescriptions for antibiotics and oral steroids thereby possibly preventing a worsening of symptoms requiring hospitalization.

The 1.4 times increased likelihood of oral steroid prescription in the education group could raise concerns regarding increased incidence of side effects such as osteoporosis. This is something to note for management of patients with COPD. Thorough education into appropriate use of steroids is necessary to avoid such an issue. Although interestingly, Gallefoss and Bakke [16] noted that the increased dispensing of steroids did not necessarily equate to an increase in consumption, there was no significant difference between the groups in defined daily dosage.

While the difference in the number of acute exacerbations in each group was not found to be statistically significant at the 95% CI, there is >15% difference between groups suggesting clinical significance [17]. Also, the number of participants who required a hospital admission for their acute exacerbation of COPD was significantly greater in the usual care group [17]. This supports the idea that people with COPD who undergo education on self-management may be less likely to allow their condition to deteriorate, and take measures to promote their health and well-being.

Inconclusive results have shown a tendency for improvement in HRQoL following disease-specific education. A possible explanation for the lack of significant findings when examining HRQoL is that the tools used to examine it are often not sensitive enough and have small effect sizes for clinically meaningful changes. The sample sizes were possibly insufficient to detect a significant difference when a clinically meaningful difference existed. A clinically meaningful difference in the StGRQ is considered to be a difference of 4 points [29, 30]. This difference in total score was found by all three studies examining the HRQoL using the StGRQ [15, 17, 25], yet only one study found a statistically significant difference [17]. The effect size to calculate a clinically meaningful difference for most domains in the StGRQ was <0.3. Therefore with a power of 80%, and an alpha of 0.05, a sample size of at least 278 was required to find a statistically significant clinically meaningful difference of >4 points between the groups. All studies had a sample size <200 and therefore when a clinically meaningful difference was obtained the power to ensure the null hypothesis was not erroneously retained was insufficient. Further research with larger sample sizes is required to examine this further.

Based on the outcomes from this review, it also appears that general HRQoL measures are not sufficiently sensitive to detect change in the COPD population. No significant findings were detected by any of the studies examining HRQoL using generic measures. Therefore, to detect changes following education in the COPD population, disease-specific HRQoL measures may be of greater benefit.

It appears that disease-specific education has little to no effect on lung function or exercise tolerance. The data suggest that education also has little or no effect on workforce changes, cognitive function, anxiety or depression, knowledge or self-reported daily symptoms, however only one or two studies have examined these outcomes and
therefore there is insufficient evidence to determine the effect education has on these outcomes.

**Elements of an effective intervention**

The studies examining didactical education delivery did not find any significant differences between groups for cognitive function, hospital admissions and length of stay, health care costs, pulmonary function, HRQoL or anxiety and depression [18–20, 24]. The only area where any differences were reported between the groups was in the number of GP visits [24]. This suggests that didactical education delivery focusing on information transmission to the COPD population may not be the most effective means of education for improving health outcomes. Although, it is important to note that despite large sample sizes, a few of the studies that used didactical education were of lower methodological quality [20, 24] which may contribute to them not finding significant differences. It appears that self-management education results in greater improvements in health outcomes, and as such future research into educational programs should focus on this educational strategy and may like to base their program on the framework of the Social Cognitive Theory of Health Behavior [31]. By improving self-management skills through programs designed to facilitate behavior change greater improvements in health outcomes may be noticed.

No specific patterns emerged as to topics which should be included in an education program as most studies included the same or similar topics. To ensure effective an efficient education, future assessment of topics for inclusion from the patients’ perspective as well as looking at health outcomes is warranted.

Also, no specific patterns of educational methodology were apparent. All studies used a variety of formats of delivery. From the current available data, it is unclear as to whether group or individually tailored education results in the better outcomes. It is unclear as to the length of time required to educate COPD people, with time ranging from 60 min through to 12 h of education. Lastly, it is also unclear as to which professionals should be delivering the education. Consideration should be given to the person delivering the education as the participant may relate on a different level and achieve greater improvements under different circumstances. Future studies comparing different educational settings and psychosocial group interactions are recommended as health care provision should meet the needs of the consumer.

**Limitations of review**

The primary limitation of this review is an inability to combine results for a meta-analysis. The previous research has used such a broad variety of outcome parameters across so many different time periods that only one or two studies have reported on any given outcome, making meta-analysis not possible or not worthwhile. Future researchers should consider this in the design of their projects and select outcome measures and assessment periods which have been readily used in the previous studies so that a meta-analysis can be performed. From this review, the primary outcome measures as determined by frequency of use within the studies were StGRQ, GP visits and costs, Physician visits and costs, hospital admissions, length of hospital stay and hospital costs, courses of antibiotic and oral steroid, rescue medication usage, the 6-min walk test and FEV₁ and FVC. Primary assessment times were immediately post-intervention, and then follow up at 6 or 12 months.

**Conclusion**

The data extracted and analyzed in this review currently form an insufficient basis to make firm recommendations as to the benefits associated with education for patients with COPD. However, we are able to conclude that disease-specific didactical education is likely to be of less benefit to this population compared with self-management education. The review also suggests that there is a tendency for improvements in quality of life and health care utilization when patients receive disease-specific self-management education, however small sample sizes and an inability to meta-analyze the data does not allow for confident recommendations.
Considering the chronic nature of the condition, the increasing prevalence and disease burden worldwide, and the success clearly noted in other trials and reviews of self-management education for other chronic diseases, further research with larger sample sizes and sufficient power and longer follow-up periods examining similar standardized outcome measures to allow for meta-analysis are required. Research examining the most effective and efficient self-management education delivery mode and when to implement the education for patients is also recommended. Self-management education may be shown to be a cost effective method of improving health outcomes for patients with COPD.

Conflict of interest statement

None declared.

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