


Models of care across the continuum of exacerbations for patients with chronic obstructive pulmonary disease

Chronic Respiratory Disease
Volume 17: 1–12
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1479973119895457
journals.sagepub.com/home/crd


Jean Bourbeau¹  and Carlos Echevarria²

Abstract

Exacerbations of chronic obstructive pulmonary disease (COPD) are associated with significant morbidity and mortality, and treatments require a multidisciplinary approach to address patient needs. This review considers different models of care across the continuum of exacerbations (1) chronic care and self-management interventions with the action plan, (2) domiciliary care for severe exacerbation and the impact on readmission prevention and (3) the discharge care bundle for management beyond the acute exacerbation episode. Self-management strategies include written action plans and coaching with patient and family support. Self-management interventions facilitate the delivery of good care, can reduce exacerbations associated with admission, be cost-effective and improve quality of life. Hospitalization as a complication of exacerbation is not always unavoidable. Domiciliary care has been proposed as a solution to replace part, and perhaps even all, of the patient's in-hospital stay, and to reduce hospital bed days, readmission rates and costs; low-risk patients can be identified using risk stratification tools. A COPD discharge bundle is another potentially important approach that can be considered to improve the management of COPD exacerbations complicated by hospital admission; it comprised treatments that have demonstrated efficacy, such as smoking cessation, personalized pharmacotherapy and non-pharmacotherapy such as pulmonary rehabilitation. COPD bundles may also improve the transition of care from the hospital to the community following exacerbation and may reduce readmission rates. Future models of care should be personalized – providing patient education aiming at behaviour changes, identifying and treating co-morbidities, and including outcomes that measure quality of care rather than focusing only on readmission quantity within 30 days.

Keywords

COPD, management of COPD, self-management of COPD, exacerbation, hospital admission, discharge care bundle, hospital at home

Date received: 7 February 2019; accepted: 16 November 2019

Introduction

Exacerbations are to chronic obstructive pulmonary disease (COPD) what myocardial infarctions are to coronary artery disease; they are acute, trajectory altering and often deadly. Furthermore, they frequently cause hospital admissions, relapses and readmissions.^{1,2} Hospitalizations due to exacerbations account for more than 50% of the cost of managing COPD, and importantly, the excess costs of COPD have rapidly increased over the years.³

¹ Respiratory Epidemiology and Clinical Research Unit, Research Institute of the McGill University Health Centre, McGill University, Montreal, Quebec, Canada

² Respiratory Department, Royal Victoria Infirmary, Newcastle upon Tyne, UK

Corresponding author:

Jean Bourbeau, Respiratory Epidemiology and Clinical Research Unit, Research Institute of the McGill University Health Centre, 5252 De Maisonneuve, Room 3D.62, Montreal, Quebec, Canada H4A 3S5.

Email: jean.bourbeau@mcgill.ca



A COPD exacerbation has been defined as an increase in shortness of breath, cough and/or sputum beyond day-to-day variation.⁴ Exacerbations can be triggered by respiratory viral infections, although bacterial infections and environmental factors such as pollution and ambient temperature may also initiate and/or amplify these events.⁵ The varying levels of exacerbation severity are (i) mild (worsening or new respiratory symptoms without a change in prescribed medication), (ii) moderate (worsening of respiratory symptoms requiring antibiotic and/or corticosteroids) and (iii) severe (requiring hospital admission).⁶

Specific therapeutic guidance has been provided to the clinician towards a more personalized approach for prevention of COPD exacerbations.⁶ Furthermore, certain countries such as the United States have begun penalizing hospitals for excessive readmissions after acute exacerbations of COPD.⁷ This is to address inconsistent care as well as to improve the overall quality and attempt to reduce readmissions. There is sparse published evidence on the effectiveness of hospital-based programmes to reduce 30-day readmissions; it comes from a Medicare study⁸ demonstrating that almost one-fifth of beneficiaries who had been discharged from a hospital were re-hospitalized within 30 days. Furthermore, there is evidence that the quality of care delivered to patients with COPD is often lacking.⁹ The 30-day readmission target may be insensitive to the needs of a complex chronic disease with long-term complications. Although this may reduce short-term healthcare system costs, there is no proof that it will improve the quality of care nor impact on long-term readmission rates. Concerns have been raised that it could exacerbate health disparities, especially in hospitals serving patients with severe COPD, multiple co-morbidities, frailty and complex psychosocial needs.¹⁰

Across the international community, efforts have been made to reduce COPD exacerbations and associated complications such as hospital admissions.^{6,11} Although treatment strategies to prevent COPD exacerbations and complications such as hospital admissions are still largely based on pharmacological therapies, evidence supports non-pharmacological treatment such as pulmonary rehabilitation and self-management programme with written action plan and coaching by a case manager to be effective treatments preventing hospital admissions.^{12,13} This is not to say that one should be chosen instead of the other, but that non-pharmacological treatment should be given a more important place in the management of chronic

disease such as COPD. Several models of care have been proposed and studied to reduce exacerbations and complications across the whole continuum of a COPD exacerbation event, with an emphasis on reducing readmissions.

A recent official American Thoracic Society (ATS) workshop at the 2016 ATS International Conference has presented and discussed approaches with the greatest potential for success in a workshop on reducing COPD hospital admissions.¹⁴ From this workshop, key themes for success emerged which can provide guidance to clinicians and service providers: (1) communication is critical; (2) interventions need to include improvements in patient education, such as self-management behaviour modification with adequate health coaching; (3) efforts need to address multi-morbidity and social determinants of health and not focus only on COPD; (4) programmes need to address quality of care and not just quantity of readmissions; the 30-day readmission metric may not be the most salient measure and the timeframe and may, therefore, need to be adjusted; (5) improvements in identifying risk factors for readmission and/or 'high risk' patients are needed and; (6) programmes will need to embrace randomized schemas or other high-quality programme evaluation designs.

The review that follows, which of note is narrative rather than systematic in nature, will present a perspective on the current state of knowledge of models of care across the continuum of exacerbations of COPD: (1) chronic care and self-management interventions with the action plan, (2) domiciliary care for severe exacerbation and the impact on readmission prevention, and (3) discharge care bundle for management beyond the acute exacerbation episode.

Chronic care management and self-management

Chronic care management has been central to care delivery for patients with chronic diseases such as diabetes, congestive heart failure and COPD. It encompasses the oversight and education activities conducted by healthcare professionals to help patients with chronic health conditions learn to understand and successfully live with their conditions. It supports the self-management abilities of chronically ill patients through education, lifestyle programmes, self-efficacy and skills building to be integrated into their day-to-day life.

Decades ago, an early multicentre, interventional trial on self-management in COPD involved continuous communication and coaching of the patients by a healthcare professional based on the ‘Living Well with COPD’ programme (<http://www.livingwellwithcopd.com>). It demonstrated a $\geq 40\%$ reduction in hospital admissions compared to usual care at 1 year,¹⁵ and a $\geq 25\%$ reduction at 2 years.¹⁶ Although heterogeneous, several trials since then have shown a reduction in exacerbations complicated by emergency department visits and hospital admissions in patients with COPD. Cochrane reviews of self-management interventions^{13,17} that include written action plans and coaching with a healthcare professional for prompt treatment of worsening symptoms have shown an improvement in patients’ health status and a reduction both of respiratory-related and all-cause hospitalizations (Table 1).

Self-management interventions require interaction between patients and healthcare professional(s) (also called a case manager or health navigator), acting as a health coach; behaviour change techniques are used to elicit patient motivation, confidence and competence.³³ Health coaching for patients with chronic conditions is growing in popularity.³⁴ A recent clinical trial has shown that providing health coaching to COPD patients following hospitalization for an exacerbation is feasible and significantly decreases the risk for readmission up to 6 months.³⁵ In this study, the intervention comprised education with action plan-based self-management and motivational interviewing. Health coaching should not be seen as a treatment, but rather as a process that needs to be part of other interventions such as self-management intervention, integrated care and pulmonary rehabilitation.³⁶ If these approaches are to be effective, self-management and health coaching require a process of iterative interactions between patients and/or relatives and must be provided from one to multiple healthcare providers with the goals of motivating, engaging and supporting the patients to better manage their disease and adopt healthy behaviours.

Tailoring the complexity/intensity of the intervention to the individual patient

It is fundamental that self-management interventions are based on the patient’s needs and capacities within the environment of a supportive healthcare system. Along the continuum of disease management, the contents and components of the programme will vary

Table 1. Approaches of care and outcomes of interest including hospital readmissions, mortality, health status and cost-effectiveness.^a

Approach of care	Respiratory readmission	All-cause readmission	Mortality ^b	Health status	Cost-effectiveness ^c
Self-management intervention with action plan					
Zwerinik et al. ¹⁷	0.57 (0.43 to 0.75)	0.77 (0.45 to 1.30)	0.79 (0.58 to 1.07)	-3.51 (-5.37 to -1.65)	Cost saving ¹⁸⁻²² QALY 0.06-0.15 ²²
Lenferink et al. ¹³	0.69 (0.51 to 0.94)	0.74 (0.54 to 1.03)	0.0019 (-0.023 to 0.026)	-2.69 (-4.49 to -0.90)	
Domiciliary care (HAH) ^d					
Jeppesen et al. (D1) ²³	Not available	0.76 (0.59 to 0.99)	0.65 (0.40 to 1.04)	Insufficient data	RCT that compared cost showed HAH is less expensive than hospital ²⁴⁻²⁸
McCurdy (D2) ²⁹	Not available	0.90 (0.70 to 1.16)	0.68 (0.41 to 1.12)	Insufficient data	
Echevarria et al. (D1&2) ³⁰	Not available	0.74 (0.60 to 0.90)	0.66 (0.40 to 1.09)	Insufficient data	
Discharge care bundle					
Ospina et al. ³¹	Not available	0.80 (0.65 to 0.99)	0.74 (0.43 to 1.28)	Insufficient evidence	Insufficient evidence

HAH: hospital at home; CI: confidence interval; COMET: COPD patient management European trial.

^aOdds ratio or relative risk with 95% CI.

^bRecent COMET²² and PIC-COPD³⁸ trial have shown the potential to reduce mortality from integrated case management with self-management interventions.

^cStudies that have assessed cost-effectiveness as part of the evaluation of the self-management¹⁸⁻²² and HAH.²⁴⁻²⁸

^dThe first meta-analysis²³ defined return to hospital during the HAH period as a readmission (D1), while the second²⁹ did not (D2), and the third³⁰ reported the results with the two definitions (D1&2).

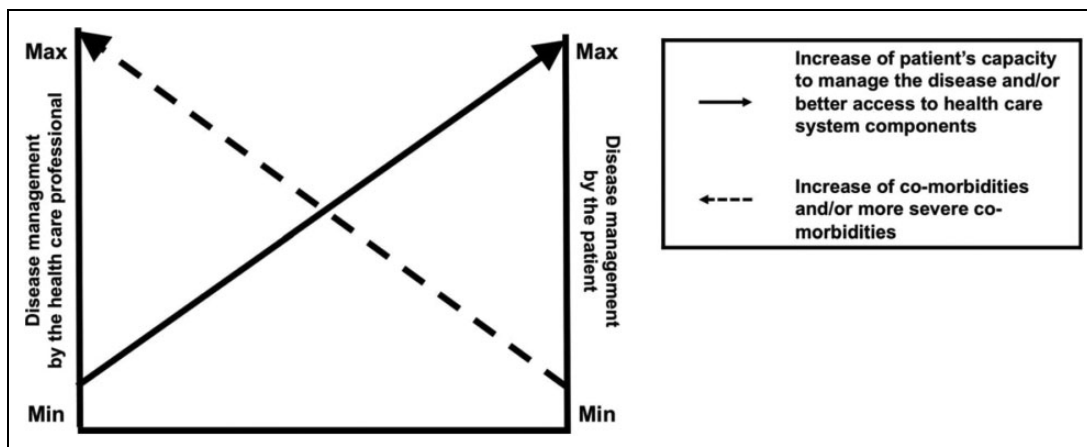


Figure 1. Disease management adapted and centred on the needs and the capacities of the patient.³⁷

to adapt to the situation of the patient and to factors such as disease severity, co-morbidities and access to healthcare. In a patient with more severe disease, who may also have co-morbidities, self-management will have to be more intensive; in other words, more interaction and support from the case manager is needed. When a patient's capacity to self-manage their condition decreases and/or the severity of illness increases as part of the trajectory of the chronic disease, disease management by the healthcare provider must increase proportionally (Figure 1).³⁷ For those with more severe illness, self-management will require greater support and monitoring to ensure patient safety. Two recent independent, well-designed studies, the COPD patient management European trial (COMET)³² and Program of Integrated Care for Patients with COPD and Multiple Comorbidities (PIC-COPD+)³⁸ have shown the potential to reduce mortality from integrated case management with self-management interventions.

Solutions that empower both patients and caregivers in their everyday life

Recently, there has been a growing interest in the use of information and communication technology to improve outcomes in chronic diseases. In COPD patients, delivering interventions by telemedicine has been very disappointing to date.³⁹ Remote monitoring of signs and symptoms and respiratory physiology alone have failed to show any benefit. Trials that have relied only on technology measurement along with remote patient monitoring platforms such as PROMETE II and CHROMED were negative.^{40,41}

It has therefore been suggested that telemedicine could be used to enhance best practice, as an adjunct

to self-management approaches assisting proper healthcare coaching. Patient engagement, also known as patient activation, is necessary for these behavioural changes to occur. COPD written action plan adherence can be further enhanced with the use of telehealth technologies in a specialized clinic with experience in COPD self-management.⁴² Patients followed up by the tele-system recovered faster from exacerbations and had a further decrease in COPD-related emergency department visits and hospitalizations. These promising results will need to be tested in a randomized clinical trial properly designed and with sufficient power. The recent COMET,^{32,43} an international open-design clinical trial in COPD patients, a disease management intervention that included a self-management programme and coaching by a case manager based on the 'Living Well with COPD' programme (<http://www.livingwellwithcopd.com>), home telemonitoring, care coordination and medical management, did not significantly reduce unplanned all-cause hospitalization days. All-cause hospitalization days per year (mean \pm SD) were 17.4 ± 35.4 and 22.6 ± 41.8 , respectively (mean difference -5.3 , 95% confidence interval (CI) -13.7 to -3.1 ; $p = 0.16$), but had fewer per-protocol acute care hospitalization days per year ($p = 0.047$), a lower BODE index ($p = 0.01$) and a lower mortality rate (1.9% vs. 14.2%; $p < 0.001$). This international study supports the feasibility of a multicomponent home-based disease management intervention in severe COPD patients (many requiring home oxygen) and demonstrated that most patients adhered to the intervention. However, patients with severe disease and multiple co-morbidities should be clearly identified as they may not be able to fully implement the programme, and thus may fail to fully benefit from it.

The increased capacity to manage and analyse patient data has led to the development of artificial intelligence algorithms to improve the management of certain chronic diseases. A widely known methodology in artificial intelligence is ‘machine learning’, which can be defined as ‘the use of computational methods using past information to improve performance or to make accurate predictions’. However, the results of studies using machine-learning techniques to ensure an early detection and appropriate treatment of COPD exacerbations are yet to be validated in randomized clinical trials and real-life scenarios. To date, our own intelligence still surpasses digital technology when it comes to the prediction and prompt recognition of COPD exacerbations. The question remains whether this will still be the case in the coming years. It is very possible that we have not yet identified the best indicators and predictors of COPD exacerbation onset.

Cost of self-management intervention

In addition to improving health outcomes, a major objective of chronic care management with self-management intervention is to improve healthcare quality and control costs, for example, by avoiding hospitalizations. Randomized controlled trials (RCTs) have shown economic benefits of these programmes in COPD patients. Tougaard et al.¹⁸ showed cost saving and Gallefoss and Bakke¹⁹ showed a cost benefit from a reduction in healthcare utilization. Bourbeau et al.²⁰ showed potential cost savings, which were based on plausible costs rather than directly measured costs. The study by Dewan et al.²¹ further supports likely cost saving, and their results are more generalizable since the trial corresponds to a real-life situation (Table 1).

The COMET, a randomized, international, multi-centre trial across four European countries compared a home-based disease management programme with usual management in four European countries in patients with severe COPD.³² An economic analysis demonstrated a cost savings of EUR 37.50 per patient per year relative to usual care in patients with severe or very severe COPD (Global Initiative for Chronic Lung Disease (GOLD) III/IV).²² These cost savings were driven by an overall reduction in the number of unscheduled all-cause hospital days.

The intervention was associated with improved 15D Health-Related Quality of Life (HRQoL), with patients in the intervention group having incremental gains in

HRQoL relative to the usual management ranging from 0.06 quality-adjusted life year (QALY) to 0.15 QALY. These values compare favourably to the HRQoL benefits of typically less than 0.10 QALY per patient associated with pharmacological treatment of COPD. A favourable health-economic result was observed when cost-effectiveness was evaluated based on QALYs and mortality (cost per death avoided); interestingly, cost-effectiveness findings were driven by a lower mortality in the intervention group as highlighted by the clinical results of COMET.

Domiciliary care for patients with COPD exacerbation

In the recent years, hospital at home (HAH) has been proposed and supported by the European Respiratory Society (ERS)/American Thoracic Society (ATS) home-based management programmes for patients with COPD exacerbation who present to the emergency department or hospital.¹¹ HAH is defined as an ‘active treatment by healthcare professionals in the patient’s home for a condition that otherwise would require acute hospital inpatient care, and always for a limited time period’.^{44,45} While HAH and early supported discharge (ESD) are sometimes used interchangeably,³⁰ HAH tends to refer to a higher intensity of care, with a more substantial reduction in the amount of time spent in hospital care, than does ESD.

Benefit of domiciliary care programmes

Three meta-analyses^{30,23,29} have been performed looking at the outcomes of domiciliary care compared to usual care for acute exacerbation (Table 1).^{30,23,29} In these analyses, results varied partly due to study selection and a difference in methods. One meta-analysis²³ published in 2012 included 8 trials of 870 patients and showed a significant reduction in readmission rates for domiciliary care compared to usual care. A non-significant trend towards reduced mortality was also shown for domiciliary care.

A second meta-analysis,²⁹ also published in 2012, criticized all included studies for lacking power and suggested caution when interpreting results. Again, there was a trend towards lower mortality, although this difference was significant when the results were stratified by the length of the follow-up period (2 months follow-up – relative risk 0.32, 95% CI 0.11 to 0.93, $p = 0.04$). Unlike the first meta-analysis, readmissions

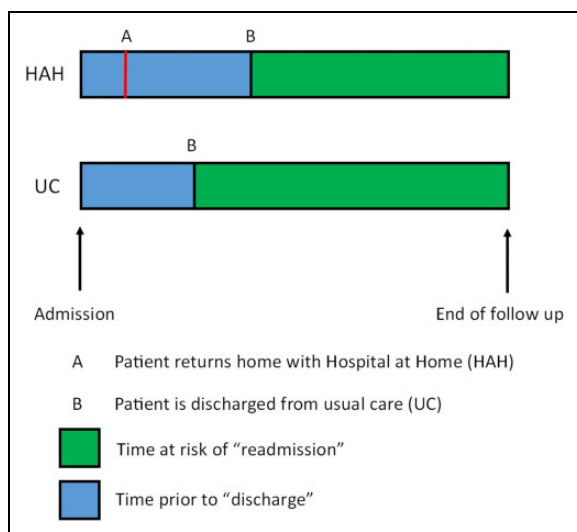


Figure 2. Illustration of variable risk exposure in HAH compared to UC. Two types of patients are shown, one receiving HAH and the other receiving UC. Patients receiving HAH will return home (red line 'A') before the patient in UC (line 'B'), and therefore may have a longer exposure to readmission if the return home is regarded as discharge and the follow-up is fixed from admission. If the follow-up time period is measured from the point the patient returns home, the patient in HAH will have had less time to recuperate, so the risk of early readmission may be higher. The average time under HAH care tends to be longer than inpatient stay with UC. Therefore, if return to hospital prior to discharge from HAH (between line 'A' and line 'B') is not defined as readmission to hospital, the patient will have either less time exposed to the risk of readmission, and will have had more time to recover at the point the risk of readmission begins. HAH: hospital at home; UC: usual care.

were not significantly reduced. The reason for this discrepancy, in part, is that the first meta-analysis defined return to hospital during the HAH period as a readmission, whilst the second did not. Neither definition of readmission is without issue, as the time exposed to readmission or the time to recuperation may be different, as illustrated in Figure 2.

The third and most recent meta-analysis³⁰ performed separate analyses for both definitions of readmission. If return to hospital was not defined as a readmission, the results were statistically significant. The effect size was smaller and not statistically significant if return to hospital was defined as a readmission (RR 0.84, 95% CI 0.69 to 1.01, $p = 0.05$). This meta-analysis varied from the others, in those patients that died prior to discharge were appropriately not regarded as at risk of readmission. From the perspective of

hospitals, not regarding return to hospital as a readmission during the domiciliary care period may reduce 30-day readmission rates. However, from the patient perspective, return to hospital may be indistinguishable from readmission in terms of its impact on health status and exposure to in-hospital hazards.

Five RCTs have compared the costs of domiciliary care to usual care, which generally showed that domiciliary care is less expensive than usual care.^{24–28} However, these trials varied in their methods and the level of detail of costing, and only two studies performed full economic evaluations. The cost-effectiveness study based in the Netherlands showed no real difference in healthcare costs between arms, though the mean difference was marginally lower for domiciliary care by 168 euros at 3 months of follow-up.²⁶ The second economic evaluation was based in the United Kingdom and showed a large mean difference in health and social costs at 90 days of 1068 euros favouring HAH, which showed non-inferiority but not superiority, with a 90% chance of cost-effectiveness.²⁵ Part of the reason for the differences in these economic evaluations may be due to inherent differences between these healthcare systems and to the selected model of care. The Netherlands-based study was of ESD, in which patients were randomized after 3 days of inpatient care. In the UK study, patients in HAH returned home the same day or the day after admission.

Patient eligibility

Patient selection for HAH is challenging as COPD exacerbations are associated with high mortality.⁴⁶ Consequently, most studies of domiciliary care had multiple inclusion and exclusion criteria to identify suitable patients, resulting in a diminished pool of suitable patients. An alternative approach is to select patients using risk stratification tools. There are several such tools that show good performance for identifying low-risk patients.⁴⁷ Only one tool, the Dyspnea, Eosinopenia, Consolidation, Acidemia and atrial Fibrillation (DECAF) score, has been shown as suitable for selecting low-risk patients within an implementation RCT which compared HAH to usual care.²⁵ A low-risk DECAF score is associated with a risk of death of 1–1.5% and may identify up to half of all patients admitted with COPD exacerbation as low risk.^{48,49}

Domiciliary models of care

Some domiciliary care models aim to prevent admission altogether by recruiting patients directly from the

emergency department.^{24,27,50} In principle, these have the greatest potential to reduce costs and avoid the risks associated with inpatient stay, though further studies are required. Most studies of domiciliary care in severe acute exacerbation are those in which the patient was admitted first, and therefore aimed to reduce hospital bed days and/or readmissions.^{25,51–54}

Domiciliary services should ideally include all those services which are available in hospital, such as all members of the multidisciplinary team, physiological observations, investigations (including blood tests and arterial blood gas analysis) and treatments (including controlled oxygen and intravenous fluids and antibiotics). However, few studies had HAH services that included most of the treatments available in the hospital,^{24,25} and in most studies nurses from the hospital performed visits. Physician reviews may be ad hoc and involve the patient returning to the hospital for investigations that are not possible at home, such as chest radiography, prior to the patient returning home a few hours later.²⁵ Oxygen should be provided in a controlled manner during the exacerbation, aiming for target saturations of 88–92%, including travel to and from hospital.⁵⁵ Finally, patients with COPD exacerbation who require hospital admission are often elderly and have multiple co-morbidities. For this reason, HAH services should include social support and rehabilitation services.

Discharge care bundle

The literature has identified factors that may place patients at higher readmission risk, but it is sparse with respect to effective interventions and cost analyses. Interventions, particularly interdisciplinary teams with bundled care have been proposed, aiming at reduction of readmission. However, success at reducing readmissions and cost savings based on these interventions varied across the studies.⁵⁶ These studies were most successful at improving the quality of care provided and demonstrated improvement in the process. Gaps in the transition from acute to community care have been identified such as lack of access to timely follow-up and disease management programmes, failure to ensure optimal vaccinations, inappropriate medication prescriptions, and failure to address smoking cessation or refer to pulmonary rehabilitation.⁵⁷ An example of a discharge care bundle is provided in Supplementary Material, Appendix 1.

A recent systematic review that included 14 studies (5 clinical trials, 7 uncontrolled trials and 2 interrupted time series) showed evidence of a reduction in hospital readmissions.³¹ A total of 26 distinct elements of care was included in the bundles of individual studies. Discharge care bundles included between 2 and 12 individual interventions (median: 5; Interquartile range (IQR): 4–9). Individual interventions most frequently included in discharge care bundles were ensuring patients demonstrated adequate inhaler technique (nine studies), educational programme on self-management (nine studies), individually tailored care plans for self-management (eight studies), assessment/referral for pulmonary rehabilitation (eight studies), arranging outpatient follow-up (eight studies) and referral to a smoking cessation programme (seven studies).

Evidence from four clinical trials with the moderate-to-high risk of bias showed that COPD discharge bundles reduce hospital readmissions (Table 1). Among non-RCT before-and-after (BA) studies, the per cent change (decrease) in 30-day hospital readmissions after bundle implementation relative to the period without discharge care bundle ranged from –6.11% to –48.5% (median per cent change: –30.5%; IQR: –19%, –37.7%). Two BA studies with longer follow-up outcome had decreases in hospital readmissions of –42.4% and –30.1% at 3 months, respectively. One BA study had a per cent decrease of –50.7% in hospital readmissions at 1 year. There is insufficient evidence that care bundles influence long-term mortality or quality of life.

Data are lacking on the effectiveness of the discharge care bundle with respect to the time period of follow-up and the type of COPD patient. In one study, bundle payments for care improvement on COPD hospitalizations had no statistically significant impact on the risk of all-cause or COPD-related readmissions within 30 or 90 days at a single large academic medical centre. Furthermore, in this study, cost was assessed; the intervention resulted in a 4.3% cost savings but did not include the costs incurred to support the programme, which far exceeded this benefit.⁵⁸ Another study took the perspective of looking at differences between patients with infrequent admissions (light users) versus the heavy users (those with three or more admissions per year). Benefit could be shown in the ‘light users’, at 90 days and at 1 year, but not within the 30-day period. However, no benefit was seen using the same discharge care

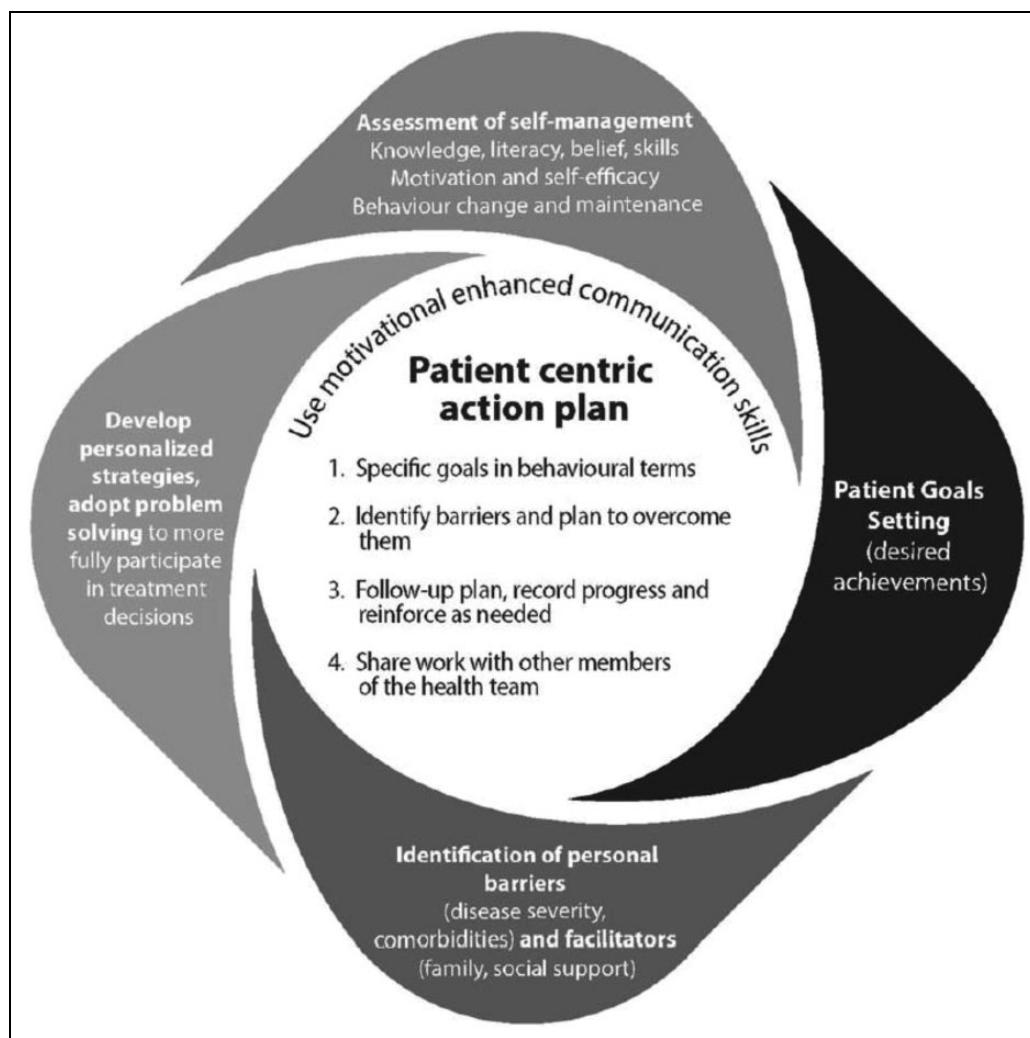


Figure 3. Self-management strategies: a first step towards personalized medicine.⁶⁰

bundle in the ‘heavy users’.⁵⁹ This could be explained by components of the discharge care planning having a delayed effect, such as smoking cessation and pulmonary rehabilitation; or by the time taken for skill acquisition and behaviour change. Collectively, this highlights the complexity of defining, and adapting, the content of the discharge care bundle for patient disease severity and co-morbidities, ensuring its delivery and patient adherence, and defining an appropriately targeted outcome. The discharge care bundle may be a good first step for COPD care, but patients with severe COPD and multiple readmissions (‘heavy users’) may require more in-depth healthcare plans, greater resources and services tailored to the specific needs of the patients to generate a measurable effect on readmission rates. More clinical research should be focused on defining the intervention

personalized to patient characteristics, success at 30 days and beyond 30-day admissions and cost savings.

Conclusion and clinical implication

Considering the major impact of acute exacerbations on COPD patient outcomes and societal burden, ongoing efforts are imperative to reduce acute exacerbations of COPD, their recurrence and associated hospital admissions. GOLD has proposed in its 2020 update a tailored approach of treatment with the main goals to reduce symptom burden and exacerbations, with a management strategy that includes pharmacologic and non-pharmacologic interventions. GOLD proposes that emphasize should be given not only to the pharmacological treatment but simultaneously to the non-pharmacological treatment in the initial and follow-up management of COPD. Furthermore,

targeting exacerbations is an important part of the tailored approach of managing COPD patients.

Published data support models of care across the continuum of the exacerbation such as (i) self-management interventions that include written action plans with healthcare professional coaching, (ii) domiciliary care to reduce hospital stay when exacerbation inevitably worsens and requires hospital admission and (iii) discharge care bundles for the management of patients beyond the acute episode. All of these interventions aim to improve quality outcomes, enhance patient well being and reduce exacerbation complications such as hospital admissions. Best care and practice may consider 30-day hospital admission as a starting point to improve the quality of care in COPD, but it should go beyond that target. Exacerbations are part of a chronic disease process and the solution to the problem needs to address the whole disease trajectory in a continuum-of-care approach. In addition to improving health outcomes, interventions such as chronic care management with self-management intervention and HAH are promising modalities for controlling costs by avoiding hospitalizations.

It is important, however, to recognize that any programme should be flexible to adapt to the situation of the patient and to factors such as disease severity, comorbidities and access to healthcare. There are still many challenges, such as determining a match between patients and the complexity/intensity of the intervention, particularly when considering advanced disease and patients with important co-morbidities, and providing solutions that empower both patients and caregivers in their everyday life. Programmes must individualize treatment based on patient characteristics, leading to an even more personal and consequently heterogeneous approach. The individual patient needs, own preferences and personal goals should inform the design of any intervention; for example, to achieve personalized self-management in COPD, a continuous feedback loop process should be implemented to constantly assess whether the desired outcomes are in fact being achieved for a given patient. This is well represented in Figure 3, self-management strategies: a first step towards personalized medicine.⁶⁰


Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Jean Bourbeau  <https://orcid.org/0000-0002-7649-038X>

Supplemental material

Supplemental material for this article is available online.

References

1. Connors AF Jr, Dawson NV and Thomas C, et al. Outcomes following acute exacerbation of severe chronic obstructive lung disease. The SUPPORT investigators (Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments). *Am J Respir Crit Care Med* 1996; 154(4 Pt 1): 959–967.
2. Suissa S, Dell’Aniello S and Ernst P. Long-term natural history of chronic obstructive pulmonary disease: severe exacerbations and mortality. *Thorax* 2012; 67(11): 957–963.
3. Khakban A, Sin DD and FitzGerald JM, et al. The projected epidemic of chronic obstructive pulmonary disease hospitalizations over the next 15 years. A population-based perspective. *Am J Respir Crit Care Med* 2017; 195(3): 287–291.
4. Wedzicha JA and Seemungal TA. COPD exacerbations: defining their cause and prevention. *Lancet* 2007; 370(9589): 786–796.
5. Woodhead M, Blasi F and Ewig S, et al. Guidelines for the management of adult lower respiratory tract infections. *Eur Respir J* 2005; 26(6): 1138–1180.
6. Vogelmeier CAA, Anzueto A and Barnes P, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive lung disease 2019 update. 2019; 5: pii: 1900164.
7. Hospital Readmissions Reduction Program (HRRP), CMS.gov, Baltimore, 2017.
8. Jencks SF, Williams MV and Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med* 2009; 360(14): 1418–1428.
9. Lindenauer PK, Pekow P and Gao S, et al. Quality of care for patients hospitalized for acute exacerbations of chronic obstructive pulmonary disease. *Ann Intern Med* 2006; 144(12): 894–903.
10. Joynt KE and Jha AK. A path forward on Medicare readmissions. *N Engl J Med* 2013; 368(13): 1175–1177.
11. Wedzicha JA, Miravittles M, Hurst JR, et al. Management of COPD exacerbations: a European Respiratory

- Society/American Thoracic Society guideline. *Eur Respir J* 2017;49(3): pii: 1600791.
12. Criner GJ, Bourbeau J, Diekemper RL, et al. Prevention of acute exacerbations of COPD: American College of Chest Physicians and Canadian Thoracic Society guideline. *Chest* 2015; 147(4): 894–942.
 13. Lenferink A, Brusse-Keizer M, van der Valk PD, et al. Self-management interventions including action plans for exacerbations versus usual care in patients with chronic obstructive pulmonary disease. *Cochrane Database Syst Rev* 2017; 8: CD011682.
 14. Press VG, Au DH and Bourbeau J, et al. Reducing chronic obstructive pulmonary disease hospital readmissions. An official American Thoracic Society workshop report. *Ann Am Thorac Soc* 2019; 16(2): 161–170.
 15. Bourbeau J, Julien M and Maltais F, et al. Reduction of hospital utilization in patients with chronic obstructive pulmonary disease: a disease-specific self-management intervention. *Arch Intern Med* 2003; 163(5): 585–591.
 16. Gadoury MA, Schwartzman K, Rouleau M, et al. Self-management reduces both short- and long-term hospitalisation in COPD. *Eur Respir J* 2005; 26(5): 853–857.
 17. Zwerink M, Brusse-Keizer M, van der Valk PD, et al. Self management for patients with chronic obstructive pulmonary disease. *Cochrane Database Syst Rev* 2014; 3: CD002990.
 18. Tougaard L, Krone T and Sorknaes A, et al. Economic benefits of teaching patients with chronic obstructive pulmonary disease about their illness. The PASTMA group. *Lancet* 1992; 339(8808): 1517–1520.
 19. Gallefoss F and Bakke PS. Patient satisfaction with healthcare in asthmatics and patients with COPD before and after patient education. *Respir Med* 2000; 94(11): 1057–1064.
 20. Bourbeau J, Collet JP, Schwartzman K, et al. Economic benefits of self-management education in COPD. *Chest* 2006; 130(6): 1704–1711.
 21. Dewan NA, Rice KL and Caldwell M, et al. Economic evaluation of a disease management program for chronic obstructive pulmonary disease. *COPD* 2011; 8(3): 153–159.
 22. Bourbeau J, Granados D and Roze S, et al. Cost-effectiveness of the COPD patient management European trial home-based disease management program. *Int J Chron Obstruct Pulmon Dis* 2019; 14: 645–657.
 23. Jeppesen E, Brurberg KG, Vist GE, et al. Hospital at home for acute exacerbations of chronic obstructive pulmonary disease. *Cochrane Database Syst Rev* 2012; 5: CD003573.
 24. Aimonino Ricauda N, Tibaldi V and Leff B, et al. Substitutive “hospital at home” versus inpatient care for elderly patients with exacerbations of chronic obstructive pulmonary disease: a prospective randomized, controlled trial. *J Am Geriatr Soc* 2008; 56(3): 493–500.
 25. Echevarria C, Gray J and Hartley T, et al. Home treatment of COPD exacerbation selected by DECAF score: a non-inferiority, randomised controlled trial and economic evaluation. *Thorax* 2018; 73(8): 713–722.
 26. Goossens LM, Utens CM and Smeenk FW, et al. Cost-effectiveness of early assisted discharge for COPD exacerbations in the Netherlands. *Value Health* 2013; 16(4): 517–528.
 27. Nicholson C, Bowler S and Jackson C, et al. Cost comparison of hospital- and home-based treatment models for acute chronic obstructive pulmonary disease. *Aust Health Rev* 2001; 24(4): 181–187.
 28. Skwarska E, Cohen G and Skwarski KM, et al. Randomized controlled trial of supported discharge in patients with exacerbations of chronic obstructive pulmonary disease. *Thorax* 2000; 55(11): 907–912.
 29. McCurdy BR. Hospital-at-home programs for patients with acute exacerbations of chronic obstructive pulmonary disease (COPD): an evidence-based analysis. *Ont Health Technol Assess Ser* 2012; 12(10): 1–65.
 30. Echevarria C, Brewin K and Horobin H, et al. Early supported discharge/hospital at home for acute exacerbation of chronic obstructive pulmonary disease: a review and meta-analysis. *COPD* 2016; 13(4): 523–533.
 31. Ospina MB, Mrklas K and Deuchar L, et al. A systematic review of the effectiveness of discharge care bundles for patients with COPD. *Thorax* 2017; 72(1): 31–39.
 32. Kessler R, Casan-Clara P, Koehler D, et al. COMET: a multicomponent home-based disease-management programme versus routine care in severe COPD. *Eur Respir J* 2018;51(1): pii: 1701612.
 33. Effing TW, Vercoulen JH and Bourbeau J, et al. Definition of a COPD self-management intervention: International Expert Group consensus. *Eur Respir J* 2016; 48(1): 46–54.
 34. Wolever RQ, Simmons LA and Sforzo GA, et al. A systematic review of the literature on health and wellness coaching: defining a key behavioral intervention in healthcare. *Glob Adv Health Med* 2013; 2(4): 38–57.

35. Benzo R, Vickers K and Novotny PJ, et al. Health coaching and chronic obstructive pulmonary disease rehospitalization. A randomized study. *Am J Respir Crit Care Med* 2016; 194(6): 672–680.
36. Roche N and Bourbeau J. Health coaching: another component of personalized medicine for patients with chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2016; 194(6): 647–649.
37. Effing TW, Bourbeau J and Vercoulen J, et al. Self-management programmes for COPD: moving forward. *Chron Respir Dis* 2012; 9(1): 27–35.
38. Rose L, Istanbulian L, Carriere L, et al. Program of integrated care for patients with chronic obstructive pulmonary disease and multiple comorbidities (PIC COPD(+)): a randomised controlled trial. *Eur Respir J* 2018; 51(1): pii: 1701567.
39. Cartwright M, Hirani SP and Rixon L, et al. Effect of telehealth on quality of life and psychological outcomes over 12 months (Whole Systems Demonstrator telehealth questionnaire study): nested study of patient reported outcomes in a pragmatic, cluster randomised controlled trial. *BMJ* 2013; 346: f653.
40. Ancochea J, Garcia-Rio F, Vazquez-Espinosa E, et al. Efficacy and costs of telehealth for the management of COPD: the PROMETE II trial. *Eur Respir J* 2018; 51(5): pii:1800354.
41. Walker PP, Pompilio PP and Zanaboni P, et al. Telemonitoring in chronic obstructive pulmonary disease (CHROMED). A randomized clinical trial. *Am J Respir Crit Care Med* 2018; 198(5): 620–628.
42. Farias R, Sedeno M and Beaucage D, et al. Innovating the treatment of COPD exacerbations: a phone interactive telesystem to increase COPD Action Plan adherence. *BMJ Open Respir Res* 2019; 6(1): e000379.
43. Bourbeau J, Casan P and Tognella S, et al. An international randomized study of a home-based self-management program for severe COPD: the COMET. *Int J Chron Obstruct Pulmon Dis* 2016; 11: 1447–1451.
44. Goncalves-Bradley DC, Iliffe S, Doll HA, et al. Early discharge hospital at home. *The Cochrane Database Syst Rev* 2017; 6: CD000356.
45. Shepperd S, Iliffe S, Doll HA, et al. Admission avoidance hospital at home. *Cochrane Database Systematic Rev* 2016; 9: CD007491.
46. Stone RA, Holzhauer-Barrie J and Lowe D, et al. COPD: who cares matters. National chronic obstructive pulmonary disease (COPD) audit programme: clinical audit of COPD exacerbations admitted to acute units in England and Wales 2014. National clinical audit report. RCP, London, February 2015.
47. Singanayagam A, Schembri S and Chalmers JD. Predictors of mortality in hospitalized adults with acute exacerbation of chronic obstructive pulmonary disease. *Ann Am Thorac Soc* 2013; 10(2): 81–89.
48. Echevarria C, Steer J and Heslop-Marshall K, et al. Validation of the DECAF score to predict hospital mortality in acute exacerbations of COPD. *Thorax* 2016; 71: 133–140.
49. Steer J, Gibson J and Bourke SC. The DECAF score: predicting hospital mortality in exacerbations of chronic obstructive pulmonary disease. *Thorax* 2012; 67(11): 970–976.
50. Davies L, Wilkinson M, Bonner S, et al. ‘Hospital at home’ versus hospital care in patients with exacerbations of chronic obstructive pulmonary disease: prospective randomised controlled trial. *BMJ* 2000; 321(7271): 1265–1268.
51. Cotton MM, Bucknall CE and Dagg KD, et al. Early discharge for patients with exacerbations of chronic obstructive pulmonary disease: a randomized controlled trial. *Thorax* 2000; 55(11): 902–906.
52. Nissen I and Jensen MS. Nurse-supported discharge of patients with exacerbation of chronic obstructive pulmonary disease. *Ugeskr Laeger* 2007; 169(23): 2220–2223.
53. Ojoo JC, Moon T and McGlone S, et al. Patients’ and carers’ preferences in two models of care for acute exacerbations of COPD: results of a randomised controlled trial. *Thorax* 2002; 57(2): 167–169.
54. Utens CM, Goossens LM, Smeenk FW, et al. Early assisted discharge with generic community nursing for chronic obstructive pulmonary disease exacerbations: results of a randomised controlled trial. *BMJ Open* 2012; 2:e001684.
55. Austin MA, Wills KE and Blizzard L, et al. Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomised controlled trial. *BMJ (Clin Res Ed)* 2010; 341: c5462.
56. Press VG, Konetzka RT and White SR. Insights about the economic impact of chronic obstructive pulmonary disease readmissions post implementation of the hospital readmission reduction program. *Curr Opin Pulm Med* 2018; 24(2): 138–146.
57. Boulet LP, Bourbeau J and Skomro R, et al. Major care gaps in asthma, sleep and chronic obstructive pulmonary disease: a road map for knowledge translation. *Can Respir J* 2013; 20(4): 265–269.

58. Bhatt SP, Wells JM and Iyer AS, et al. Results of a Medicare bundled payments for care improvement initiative for chronic obstructive pulmonary disease readmissions. *Ann Am Thorac Soc* 2017; 14(5): 643–648.
59. Shorofsky M, Lebel M and Seden M, et al. Discharge care bundle for patients with acute exacerbations of COPD: benefit more likely to be seen beyond 30 days. *Int J Respir Pulm Med* 2015; 2: 024.
60. Barrecheguren M and Bourbeau J. Self-management strategies in chronic obstructive pulmonary disease: a first step toward personalized medicine. *Curr Opin Pulm Med* 2018; 24(2): 191–198.