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REVIEW

Implementing an Evidence-Based COPD Hospital Discharge Protocol: A Narrative Review and Expert Recommendations

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ABSTRACT

Discharge bundles, comprising evidence-based practices to be implemented prior to discharge, aim to optimise patient outcomes. They have been recommended to address high readmission rates in patients who have been hospitalised for an exacerbation of chronic obstructive pulmonary disease (COPD). Hospital readmission is associated with increased morbidity and healthcare resource utilisation, contributing substantially to the economic burden of COPD. Previous studies suggest that COPD discharge bundles may result in fewer hospital readmissions, lower risk of mortality and improvement of patient quality of life. However, evidence for their effectiveness is inconsistent, likely owing to variable content and implementation of these bundles. To ensure consistent provision of high-quality care for patients hospitalised with an exacerbation of

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COPD and reduce readmission rates following discharge, we propose a comprehensive discharge protocol, and provide evidence highlighting the importance of each element of the protocol. We then review care bundles used in COPD and other disease areas to understand how they affect patient outcomes, the barriers to implementing these bundles and what strategies have been used in other disease areas to overcome these barriers. We identified four evidence-based care bundle items for review prior to a patient's discharge from hospital, including (1) smoking cessation and assessment of environmental exposures, (2) treatment optimisation, (3) pulmonary rehabilitation, and (4) continuity of care. Resource constraints, lack of staff engagement and knowledge, and complexity of the COPD population were some of the key barriers inhibiting effective bundle implementation. These barriers can be addressed by applying learnings on successful bundle implementation from other disease areas, such as healthcare practitioner education and audit and feedback. By utilising the relevant implementation strategies, discharge bundles can be more (cost-)effectively delivered to improve patient outcomes, reduce readmission rates and ensure continuity of care for patients who have been discharged from hospital following a COPD exacerbation.

Keywords: Care bundles; Chronic obstructive pulmonary disease; Discharge protocol; Exacerbation; Hospital readmission; Implementation strategies

Key Summary Points

Patients hospitalised for an exacerbation of COPD have high readmission rates and experience an increased risk of mortality.

Evidence suggests that COPD discharge bundles may reduce hospital readmissions and risk of mortality and improve patient quality of life; however, poor compliance with discharge bundles is challenging our ability to understand how discharge bundles affect clinical outcomes in COPD.

This review proposes a comprehensive COPD hospital discharge protocol consisting of four evidence-based care bundle items, and reviews care bundles used in COPD and other disease areas.

By applying learnings from other disease areas and using implementation strategies such as healthcare practitioner education and audit and feedback, COPD hospital discharge bundles can be more (cost-)effectively delivered to improve patient outcomes and address high COPD readmission rates.

DIGITAL FEATURES

This article is published with digital features, including an infographic, to facilitate understanding of the article. To view digital features for this article, go to https://doi.org/10.6084/m9.figshare.23635008.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is defined in the 2023 Global Initiative for Chronic Obstructive Lung Disease (GOLD) report as "a heterogeneous lung condition characterised by chronic respiratory symptoms (dyspnoea, cough, sputum production) due to abnormalities of the airways (bronchitis,

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bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, airflow obstruction" [1, 2]. It is the third leading cause of death globally and affects ~ 390 million people worldwide [3, 4].

Up to 70% of patients with COPD experience exacerbations [5], which can irreversibly reduce lung function and increase the risk of future cardiopulmonary events (exacerbations, cardiovascular complications) and mortality [6–8]. Furthermore, up to 31% and 19% of exacerbations have been shown to require emergency department (ED) attendance or hospital admission, respectively [9]. Up to 24% of patients hospitalised for an exacerbation are readmitted within 30 days of discharge [10–13], and ~ 40% of patients are readmitted or die within 90 days of discharge [14]. Therefore, exacerbations should be optimally managed, including the optimisation of preventative interventions; however, in clinical practice, exacerbations are often inadequately prevented and under-treated [15–18].

Hospital readmission is associated with increased morbidity and healthcare resource utilisation, contributing significantly to the economic burden of COPD [19–21]. Therefore, it is crucial to ensure continuous care, optimise treatment, and reduce morbidity and mortality when patients with COPD are being discharged from hospital following an acute exacerbation of COPD.

Discharge bundles consist of a short list of evidence-based practices to be implemented prior to hospital discharge to optimise patient outcomes [22, 23]. They have been recommended to address high COPD readmission rates to ensure consistent provision of high-quality care. However, despite the availability of evidence-based interventions, discharge bundles have been implemented with varying success [24, 25]. A systematic review of the effectiveness of COPD discharge bundles showed that discharge bundles for patients with COPD led to fewer readmissions, but did not significantly improve mortality or quality of life (QoL) [24].

The aim of the current review was first to develop a comprehensive hospital discharge protocol based on national and international guidelines and key elements of existing discharge protocols [1, 26–28]. Second, we have examined previously studied discharge bundles used in COPD and other disease areas and highlight implementation barriers. Finally, we propose recommendations for the successful implementation of the proposed COPD hospital discharge protocol.

PROPOSED COPD HOSPITAL DISCHARGE PROTOCOL

We have developed a practical and globally implementable COPD hospital discharge protocol (Fig. 1) intended for patients being discharged from hospital following an exacerbation. Four evidence-based care bundle items were identified for review prior to a patient's discharge from hospital following an exacerbation: (1) smoking cessation and assessment of environmental exposures, (2) treatment optimisation, (3) pulmonary rehabilitation (PR) and (4) continuity of care.

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Smoking Cessation and Assessment of Environmental Exposures

Smoking cessation refers to an intervention to support the discontinuation/quitting of tobacco smoking, including vapour or heated tobacco products, for all patients with COPD who are active smokers. A systematic review showed that the most effective smoking cessation strategy in patients with COPD consists of pharmacotherapy combined with behavioural counselling [29]. COPD care that offers smoking cessation interventions such as counselling and pharmacotherapy is also more cost-effective than care that does not offer such interventions [30]. Smoking cessation is important to minimise further permanent damage to the lungs [31]. It results in transient improvements in lung function as well as improvements in health-related quality of life (HRQoL) [31, 32].

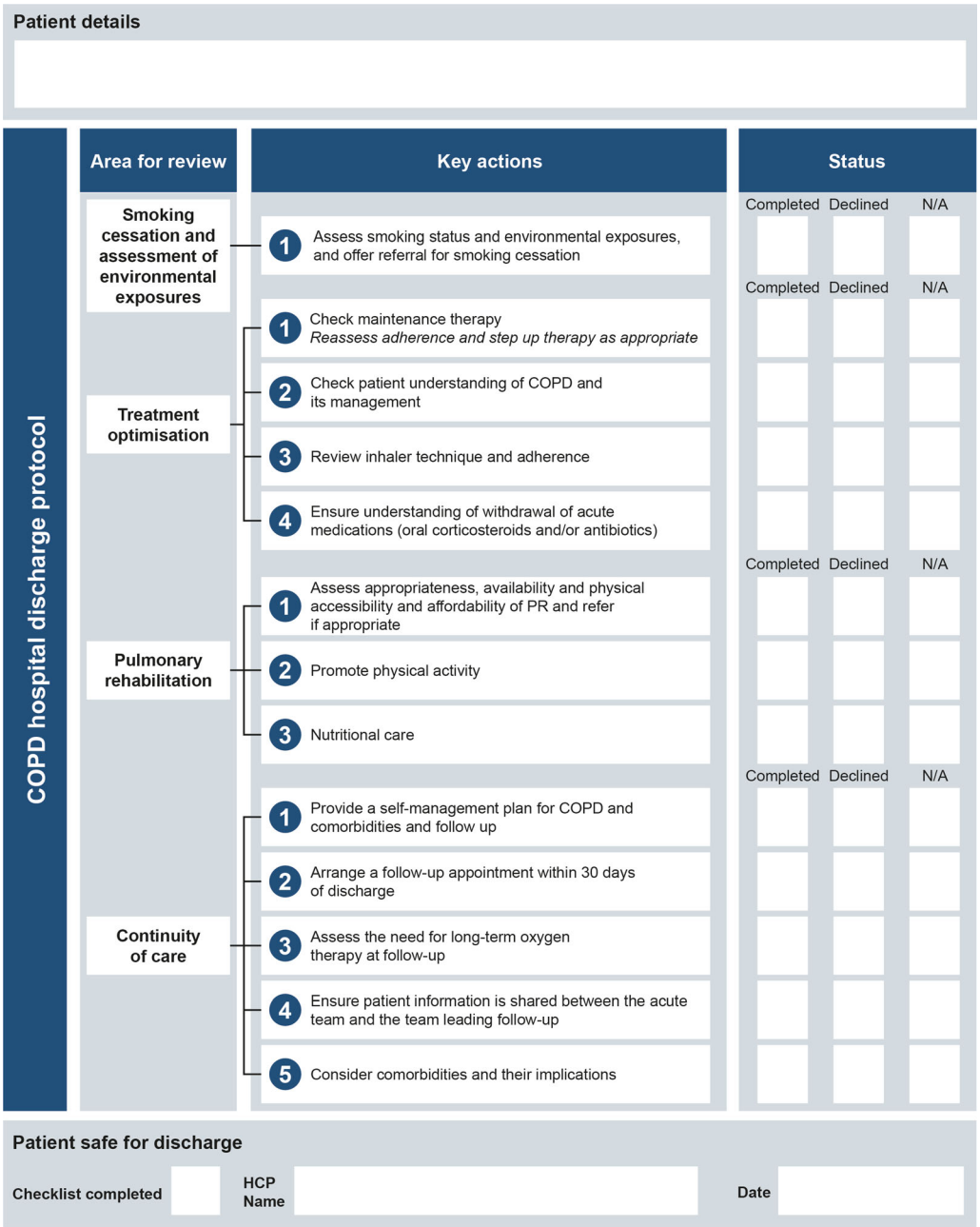


Fig. 1 Proposed hospital discharge protocol. *COPD* chronic obstructive pulmonary disease, *HCP* healthcare professional, *N/A* not applicable, *PR* pulmonary rehabilitation

In a randomised trial, patients with COPD who underwent a 10-week smoking cessation intervention programme and were followed up 14.5 years later had a reduced mortality rate compared with the usual care group [33]. Furthermore, a 22% reduction in exacerbation risk in ex-smokers compared with current smokers has been reported [34].

Environmental exposure to tobacco smoke, indoor air pollution and occupational dust, fumes and chemicals are key risk factors for the development and worsening of COPD [3]. Studies have shown that exposure to major air

pollutants increases the risk and burden of COPD exacerbations [35, 36]. As such, guidelines recommend that these exposures are avoided or reduced as part of the management of patients with COPD [1].

Smoking cessation assistance should be offered to all patients with COPD who are active smokers, and strategies for reducing environmental exposures should be discussed prior to their discharge.

Treatment Optimisation

Treatment optimisation involves reassessing the treatment plan for every hospitalised patient with COPD and ensuring that patients receive the most appropriate pharmacological and/or non-pharmacological treatment at the right time.

Check Maintenance Therapy

Global and local guidelines recommend that patients are established on their optimal maintenance therapy at hospital discharge, based on an individualised assessment of symptoms and exacerbation risk [1, 37]. However, even after hospitalisation, many patients remain suboptimally treated for COPD. For example, in a retrospective, population-based observational cohort study of Swedish patients hospitalised with an exacerbation, 16.6% of patients had not received maintenance COPD treatment during a 4-month period following the date of their first hospitalisation [38].

The 2023 GOLD report recommends initial treatment for patients hospitalised with an exacerbation (Group E patients) with either long-acting β_2-agonists (LABA) + long-acting muscarinic antagonists (LAMA), or LABA + LAMA plus inhaled corticosteroids (ICS), if blood eosinophils are $\geq$ 300 cells/μL [1].

If recurrent exacerbations occur despite maximal bronchodilation, patients should be treated according to patient phenotype. In patients with blood eosinophils $\geq$ 300 cells/μL (prior to use of oral steroids) receiving monotherapy or patients with blood eosinophils $\geq$ 100 cells/μL receiving LABA + LAMA, the 2023 GOLD report recommends escalation to LABA + LAMA + ICS as follow-up treatment [1]. LABA + LAMA + ICS has been shown to prevent exacerbations and may reduce mortality in exacerbating patients with moderate to very severe COPD compared with dual therapies [39, 40], and prompt initiation of LABA + LAMA + ICS after discharge has been shown to reduce future exacerbations and healthcare resource utilisation compared with delayed and very delayed initiation [41].

If patients with chronic bronchitis receiving LABA + LAMA + ICS (or LABA + LAMA with blood eosinophils < 100 cells/μL) continue to experience exacerbations despite adherence to therapy, treatment with a phosphodiesterase-4 inhibitor (roflumilast) or high-dose mucolytic agents should be considered [1, 42]. In patients who experience frequent bacterial exacerbations and/or bronchiectasis, addition of mucolytic agents or a macrolide antibiotic (e.g. azithromycin) may be indicated [1, 42].

Patients being treated for an exacerbation without a confirmed COPD diagnosis should still receive a discharge bundle and should be referred for lung function testing. This should be carried out at least 4 weeks after the date of admission to allow lung function to recover post-exacerbation [8, 43], although there is also a rationale for including/excluding airflow obstruction at the point of discharge if there is concern about inadequate follow-up.

Check Patient Understanding of COPD and Its Management

The patient's understanding of COPD and its management should also be assessed at discharge, and, if required, educational initiatives should be implemented where possible. Education is recommended in the global quality standard position statements for health and system policy changes in the diagnosis and management of COPD [44]. Improved patient understanding of the disease and its management has been shown to improve medication adherence and reduce urgent healthcare utilisation for patients with COPD [45, 46]. Previously hospitalised patients with COPD who received a disease-specific self-management programme and educational intervention with supervision and support from a healthcare professional (HCP) resulted in a 39.8% reduction in

admissions, a 41.0% reduction in visits to the ED and greater improvements in QoL scores compared with patients receiving usual care [47]. However, educational programmes of this nature can be costly to implement and may not be practical in many healthcare settings; therefore, delivery methods of educational programmes should be carefully considered.

In order to optimise communication and accommodate patients with lower health literacy and cultural differences, educational materials should be adapted to individual needs; these materials may include written or pictorial information, videos, personalised written information on medication regimens and teaching of self-management skills [48].

Review Inhaler Technique and Adherence

Incorrect or suboptimal inhaler technique and medication non-adherence are both common in COPD [49], are associated with increased risk of hospitalisation, ED visits, poor disease control and mortality, and incur higher costs [50, 51]. Furthermore, transitions between hospital and community settings may increase the risk of unintentional medication discontinuation. A retrospective cohort study in Canada found that patients who were hospitalised had a higher risk of unintentionally discontinuing their long-acting bronchodilator medications than those who had not been hospitalised [52]. A possible explanation is that short-acting bronchodilators are often used in the hospital setting in place of the patient's prescribed long-acting bronchodilator inhaler, which in some cases may not be reinitiated upon discharge.

HCPs should ensure that the inhalation device selected is optimal and tailored to the needs of the patient. As each inhaler offers different technical properties, appropriate selection of inhalation devices is integral to increasing the likelihood of achieving optimal medication adherence and disease outcomes [53]. Although choice of inhalation devices for patients with COPD depends on a variety of factors, lung deposition and inspiratory flow rate are especially important to consider [54]. Simple devices are available to measure peak inspiratory flow, which can help to guide appropriate inhaler choice.

Patients with COPD should have their inhaler technique assessed by an HCP in hospital, and adequate inhaler technique should be demonstrated by the patient, prior to discharge. Among others, pharmacist-led interventions (e.g. education on COPD, inhaler technique and the importance of medication adherence, self-management meetings and counselling sessions) have a positive effect on inhaler technique and medication adherence in patients with COPD [55, 56], while also being cost-effective [57].

Ensure Understanding of Withdrawal of Acute Medications (Oral Corticosteroids and/or Antibiotics)

Treatment with oral corticosteroids (OCS) for COPD exacerbations shortens recovery time and hospital length of stay (LoS), and also improves the rate of recovery in lung function [58–61]. However, although OCS play a role in the acute management of exacerbations, they should not be used in the long-term management of COPD, as long-term use is associated with an increased risk of adverse effects, such as pneumonia [62].

When properly indicated, antibiotics can shorten exacerbation recovery time and LoS, and reduce the risk of early relapse and treatment failure [1, 61]. Shorter exposure to antibiotics may decrease the risk of developing antimicrobial resistance and associated complications [1].

At discharge, patient understanding of plans to withdraw acute medications, such as OCS or antibiotics, should be checked, and patients should be educated on the reasons for medication withdrawal if a lack of understanding is identified.

PULMONARY REHABILITATION (PR)

PR refers to patient-tailored therapies that are designed to improve the physical and psychological condition of patients with COPD and promote long-term patient adherence to health-enhancing behaviours (e.g. exercise training,

disease- and treatment-specific education, nutritional support or therapy, and self-management plans) [1]. PR should be considered for all patients in GOLD Groups B and E, as it is associated with improvements in physical condition, including dyspnoea, health status, exercise tolerance and a reduction in exacerbations [1, 63]. If appropriate, PR referral should be initiated in hospital prior to discharge to be continued following discharge.

Assess Appropriateness, Availability and Physical Accessibility and Affordability of PR and Refer If Appropriate

Initiation of PR within 3 months of discharge in patients hospitalised for COPD is associated with fewer hospitalisations and a lower risk of mortality in the following year [64, 65]. Supervised PR during the recovery period after an exacerbation can also improve HRQoL and walking distance [66]. Despite the strong evidence base, PR services are not always commissioned [67], and there are poor referral uptake rates for early outpatient PR [68]. Although there may be several contributing factors, it is important to acknowledge that some patients have difficulty accessing PR for various reasons, including lack of availability, social isolation, costs, transportation difficulties and feeling unwell [69, 70]. Home-based PR and tele-rehabilitation programmes may mitigate for some of these barriers [70].

Promote Physical Activity

Decreased physical activity in patients with COPD is associated with reduced QoL, increased risk of comorbid disease, and increased rates of hospitalisation and mortality [1]. Physical activity is associated with a lower risk of exacerbations and mortality in patients with COPD [71]. A greater quantity of low-intensity physical activity has also been shown to reduce the risk of COPD hospitalisation [72].

Nutritional Care

Malnutrition has been reported in 30–60% of patients hospitalised with COPD [73] and is linked to decreased lung function, greater rates of hospitalisation, poor exercise tolerance, reduced QoL and increased mortality [74–79]. Although nutritional support has not been consistently shown to improve lung function [80–83], treatment that incorporates rehabilitation with nutritional support and protein supplementation may improve fat-free mass, body mass index (BMI) and exercise performance [84]. Furthermore, the use of oral nutritional supplementation in patients hospitalised with a diagnosis of COPD has been shown to reduce 30-day readmission rates [85].

BMI should be assessed and appropriate advice provided at discharge, as low BMI and weight loss in patients with COPD who are not overweight are associated with an increased risk of readmission and mortality [20, 86]. Sarcopenia should also be considered at discharge (using functional assessments and measurement of fat-free mass as markers for loss of muscle mass), as fat-free mass is related to LoS and mortality [74, 87].

CONTINUITY OF CARE

Continuity of care involves following up with patients after hospital discharge to review risk factors, symptoms, lung function, prognosis and their self-management plan to ensure they return to a stable clinical state in the community [1].

Provide a Self-Management Plan for COPD and Comorbidities, and Follow-up

At discharge, HCPs should assess whether patients with COPD have a tailored self-management plan in place. This should cover triggers, prevention and early recognition of exacerbations and appropriate follow-up, including primary care and community pharmacy visits to review inhaler technique, treatment adherence and manage comorbidities

[25]. Advance care planning should also be discussed with patients at discharge.

Arrange a Follow-up Appointment Within 30 Days of Discharge

Follow-up within 7–30 days of discharge of patients with COPD was associated with a reduced risk of readmission, ED visits and mortality compared with usual care or no follow-up [25, 88]. Follow-up can be carried out in person or virtually, which may be more convenient for patients who have difficulty accessing their healthcare provider; however, virtual appointments may not always be suitable if specific testing is required.

If possible, a follow-up call should be arranged within 72 h of discharge. Telephone follow-up after hospital discharge has been shown to increase patient satisfaction and treatment adherence [89]. Furthermore, pharmacist-led post-discharge telephone follow-up was associated with reduced readmission rates in polypharmacy patients [90]. Telephone follow-up has also had a positive impact on healthcare costs, patient beliefs about medicines, treatment adherence and patient satisfaction [90].

Assess Need for Long-term Oxygen Therapy at Follow-up

Patients who have persistent hypoxaemia should be assessed for long-term oxygen therapy at follow-up [28]. Long-term oxygen therapy can improve survival and reduce the risk of hospitalisation for patients with COPD and severe hypoxaemia [91–94]. Adherence to home oxygen therapy is predicted by increasing age and use of ambulatory oxygen; however, it often remains suboptimal [95].

The addition of home non-invasive ventilation to home oxygen therapy may also improve outcomes in patients with persistent hypercapnia following hospitalisation for an exacerbation, and has been shown to prolong the time to readmission or death within 12 months [96].

Ensure Patient Information is Shared Between the Acute Team and the Team Leading Follow-up

Discussion and information sharing between the hospital acute team and the team(s) that will continue the care are key to successful follow-up in patients with COPD who have been discharged from hospital. For example, Casas et al. showed that an individually tailored care plan that was shared with the primary care team upon discharge effectively prevented hospitalisations for exacerbations in patients with COPD after 12 months of follow-up [97]. High-quality discharge summaries that were sent to outpatient clinicians were also shown to reduce readmissions in patients with heart failure (HF) [98].

Consider Comorbidities and Their Implications

Hospital admission and readmission for non-respiratory events are common among patients with COPD and should be considered to effectively address the burden of hospitalisation in COPD [99]. Studies have shown that 76–86% of patients with COPD have at least one comorbidity [100, 101]. Common comorbidities in patients with COPD include cardiovascular disease (such as HF), lung cancer, bronchiectasis, anxiety and depression disorders, and osteoporosis [102, 103].

Evidence suggests that these comorbidities reduce QoL and increase the risk of exacerbations and mortality [102, 104]. Depression and anxiety, in particular, have been recognised as important risk factors for readmission following

hospitalisation for an exacerbation, particularly in patients with poor HRQoL [105, 106]. Risk of readmission is also increased for patients who present with multiple comorbidities [20]. To ensure comorbid conditions are managed/monitored, it is important to ensure proper handover of care and to advise patients to check their comorbidities with their primary care physician at their next appointment following discharge.

REVIEW OF PREVIOUS COPD HOSPITAL DISCHARGE BUNDLES

Numerous discharge bundles for patients hospitalised for an exacerbation have already been evaluated and have yielded variable results (Table 1) [24]. These studies have used different outcome measures, including hospital readmissions, ED visits, mortality, hospital LoS and QoL. Some studies have shown that COPD discharge bundles are associated with decreased rates of hospital readmission and a lower risk of mortality [25, 107, 108]; however, these findings have not been consistently reported [97, 108–110]. Patient QoL has been shown to improve with the implementation of COPD discharge bundles [109, 111], yet uncertainty remains regarding the effect on ED visits and hospital LoS [107, 112, 113].

LIMITATIONS OF PREVIOUS COPD HOSPITAL DISCHARGE BUNDLES

The key limitation of COPD hospital discharge bundles has been the variability in levels of implementation, which has been commonly observed across studies. In the Atwood et al. study on the effectiveness of a COPD transition bundle on hospital readmission and ED visits, the mean uptake of the bundle across sites was only 19.2% [107]. Morton et al. also reported low implementation in their study: patients, on average, received 2.8 of 5 discharge bundle elements in the implementation sites [114]. Higher rates of discharge bundle implementation have been reported in other studies: 75.5% of patients admitted to hospitals participating in the National Asthma and COPD Audit Programme in the UK received a discharge bundle; however, delivery of individual items considered part of the bundle varied significantly among patients [115].

BARRIERS TO CARE BUNDLE IMPLEMENTATION

Key barriers to discharge bundle implementation, as identified by qualitative studies, include resource constraints, lack of staff engagement and knowledge, lack of appropriate allocation of tasks, complexity of the COPD population and misdiagnosis of COPD [116–118].

Resource Constraints

High volumes of patients and hospital staff shortages mean that there can be insufficient time to ensure that individual care bundle items are regularly executed [116, 117]. In three HCP and manager focus groups that explored the challenges of care bundle implementation, staff being too busy was consistently voted as a crucial barrier [116]. Furthermore, interviews with British HCPs revealed that staff viewed themselves as ‘firefighting’ and felt that they were lacking the resources required to deliver quality care and take on quality improvement initiatives [118].

Lack of Staff Engagement

Negative experiences with care bundle implementation in the past can lead to scepticism

Table 1 Characteristics and outcomes of individual studies of discharge care bundles administered to patients with an exacerbation. Adapted from [24] with permission of BMJ Publishing Group Limited

Study; country; design	Intervention, comparison groups (*n*)	Outcomes and results	Significant result
Abad-Corpa et al. [109]; Spain; CCT	COPD discharge planning with care bundle ($n = 56$), usual care ($n = 87$)	Hospital readmissions (%) f/u: nr Bundle: 43%; usual care: 47%; ns Mortality (%) f/u: nr Bundle: 13%; usual care: 20%; ns QoL: SGRQ score (mean ± SD) f/u: 3 mo, 6 mo 3 mo: bundle: 46.5 ± 22.7; usual care: 46.7 ± 21.9; $p = 0.02$* 6 mo: bundle: 46.7 ± 23.3; usual care: 44.2 ± 22.6; $p = 0.02$*	Yes
Atwood et al.[a] [107]; Canada; RCT	COPD transition bundle ($n = 604$), usual care ($n = 3106$)	Hospital readmissions (%) f/u: 7 d, 30 d, 90 d 7 d: bundle: 1%; usual care: 5.5%; $p < 0.001$* 30 d: bundle: 15.1%; usual care: 18.2%; $p = 0.006$* 90 d: bundle: 35.2%; usual care: 35%; $p = 0.446$ ED revisit (%) f/u: 30 d Bundle: 36.1%; usual care: 24.5%; $p < 0.001$* Median hospital LoS (d) Bundle: 6 d; usual care: 5 d; $p = 0.034$* Follow-up with PCP within 14 d of discharge (%) Bundle: 47.7%; usual care: 31.1%; $p = 0.002$*	Yes

Table 1 continued

Study; country; design	Intervention, comparison groups (*n*)	Outcomes and results	Significant result
Casas et al. [97]; Spain, Belgium; RCT	COPD discharge bundle within integrated care plan ($n = 65$), usual care ($n = 90$)	Hospital readmissions (%) f/u: 1 yr Bundle: 23%; usual care: 29%; $p = 0.028$* Mortality (%) 1 yr Bundle: 19%; usual care: 16%; $p = 0.67$ Physician visits (rate per patient/yr) 1 yr Bundle: 18.4%; usual care: 16.6%; $p = 0.45$	Yes
Cousse et al. [a] [113]; France; retrospective cohort study	COPD discharge bundle ($n = 62$), usual care ($n = 202$)	Hospital readmissions or deaths (%) f/u: 28 d, 90 d 28 d: bundle: 16.1%; usual care: 14.9%; $p = 0.81$ 90 d: bundle: 29%; usual care: 27.2%; $p = 0.78$ Median time to readmission or death (d) Bundle: 134 d; usual care: 263 d; $p = 0.55$ Overall survival: HR 0.66 (95% CI 0.29, 1.48); $p = 0.31$ Annualised number of deaths/exacerbations (readmission or death/person/yr) Bundle: 1.52; usual care: 1.18; $p = 0.16$	No
Jennings et al. [128]; USA; RCT	COPD discharge bundle ($n = 93$), usual care ($n = 79$)	Hospital readmissions (%) f/u: 30 d Bundle: 19.4%; usual care: 22.8%; $p = 0.58$	No

Table 1 continued

Study; country; design	Intervention, comparison groups (*n*)	Outcomes and results	Significant result
Lainscak et al. [110]; Slovenia; RCT	COPD discharge care bundle ($n = 118$), usual care ($n = 135$)	Hospital readmissions (%) f/u: 6 mo Bundle: 31%; usual care: 44%; $p = 0.033$* Mortality (%) 6 mo Bundle: 9.3%; usual care: 9.6%; $p = 0.93$ QoL: SGRQ score (mean ± SD) 6 mo: bundle: 55.4 ± 18.8; usual care: 53.8 ± 18.6; $p = 0.33$	Yes
Linden and Butterworth [108]; USA; RCT	Components of transitional care model at discharge ($n = 124$), usual care ($n = 131$)	Hospital readmissions (rate per person/time) f/u: 30 d, 90 d 30 d: bundle: 0.218; usual care: 0.198; $p = 0.75$ 90 d: bundle: 0.50; usual care: 0.56; $p = 0.613$ ED returns (rate per person/time) 30 d, 90 d 30 d: bundle: 0.129; usual care: 0.16; $p = 0.556$ 90 d: bundle: 0.29; usual care: 0.27; $p = 0.761$ Mortality (%) 90 d Bundle: 3.2%; usual care: 11.5%; $p = 0.01$*	Yes
Graham [129]; UK; ITS	COPD discharge care planning period ($n =$ nr), no bundle period (previous year) ($n =$ nr)	Hospital readmissions (%) f/u: nr Bundle: 12.8%; no bundle: 14.9%; $p =$ nr; percent change: − 14.10% Mortality (%) f/u: 1 yr Bundle: 6.19%; no bundle: 4.38%; $p =$ nr	Unclear

Table 1 continued

Study; country; design	Intervention, comparison groups (*n*)	Outcomes and results	Significant result
Laverty et al. [130]; UK; ITS	COPD discharge bundle (n = nr), no bundle period (previous year) (n = nr)	Hospital readmissions (mean annual) f/u: 28 d, 90 d 28 d: bundle: − 5.3%; no bundle: 2.1%; $p = 0.01$ 90 d: bundle: − 1.3%; no bundle: 1.4%; $p = 0.26$	Yes
Halpin et al. [131]; UK; BA	COPD discharge care planning period ($n = 67$), no bundle period ($n = 257$)	Hospital readmissions (%) f/u: 30 d Bundle: 18%; no bundle: 27%; p = nr; percent change: − 33%	Unclear
Hopkinson et al. [23]; UK; BA	COPD discharge bundle ($n = 94$), no bundle period ($n = 365$)	Hospital readmissions (%) f/u: 30 d Bundle: 10.8%; no bundle: 16.4%; p = nr; percent change: − 34.1%	Unclear
Matthews et al. [132]; UK; BA	COPD discharge bundle (n = nr), no bundle period (n = nr)	Hospital readmissions (%) f/u: 30 d Bundle: 17.8%; no bundle: 23.2%; p = nr; percent change: − 23.4%	Unclear
Morton et al.[a] [114, 133]; UK; BA	COPD care bundle (n = nr), usual COPD care (n = nr)	COPD hospital readmissions (%) f/u: 28 d, 90 d 28 d: bundle: 10.8%; no bundle: 14.7% 90 d: bundle: 21.3%; no bundle: 26.1% All-cause readmissions (%) f/u: 28 d Bundle: 19.8%; no bundle: 25.8% Median hospital LoS (d) Bundle: 4 d; no bundle: 3 d In-hospital mortality (%) Bundle: 3.3%; no bundle: 3.9% Mortality (%) f/u: 90 d Bundle: 5.2%; no bundle: 6.5%	No

Table 1 continued

Study; country; design	Intervention, comparison groups (*n*)	Outcomes and results	Significant result
Sewell et al.[a] [134]; UK; analysis of audit data	COPD discharge bundle ($n = 1170$), usual care ($n = 572$)	Mean hospital LoS (d) Bundle: 6.17 d; no bundle: 7.08 d; $p =$ nr	Unclear
Seymour and Nedelcu [135]; UK; BA	COPD discharge care planning period ($n = 103$), no bundle period ($n = 53$)	Hospital readmissions (%) f/u: 30 d, 3 mo 30 d: bundle: 17.5%; no bundle: 34%; $p = 0.03$; percent change: − 48.5% 3 mo: bundle: 36.9%; no bundle: 52.8%; $p = 0.06$; percent change: − 30.1%	Yes
Shorofsky et al. [136]; Canada; BA	COPD discharge bundle ($n = 210$), no bundle period ($n =$ nr)	Hospital readmissions (%) f/u: 90 d, 1 yr 90 d: bundle: 18.6%; no bundle: 32.2%; $p = 0.017$*; percent change: − 42.4% 1 yr: bundle: 30.5%; no bundle: 61.9%; $p = 0.038$*; percent change: − 50.7%	Yes
Stone et al.[a] [137]; UK; longitudinal study of audit data	COPD discharge bundle ($n = 15{,}261$), no bundle period ($n = 13{,}084$)	Hospital readmissions (OR, 95% CI) f/u: 30 d, 90 d 30 d: bundle relative to no bundle: 1.02 (0.96, 1.09) 90 d: bundle relative to no bundle: 1.07 (1.01, 1.12); $p =$ nr* Mortality (OR, 95% CI) f/u: 30 d, 90 d 30 d: bundle relative to no bundle: 0.93 (0.78, 1.09) 90 d: bundle relative to no bundle: 1.03 (0.93, 1.13)	Yes
Westbroek et al.[a] [25]; Netherlands; prospective cohort study	COPD care pathway period ($n = 752$), no COPD care pathway period ($n = 752$)	Reduction in number of total hospitalisation days (pre- vs post-care pathway implementation) (%) 19.4%; $p =$ nr	Yes

Table 1 continued

Study; country; design	Intervention, comparison groups (*n*)	Outcomes and results	Significant result
Yip et al. [138]; USA; BA	COPD discharge care planning period (n = nr), no bundle period (n = nr)	Hospital readmissions (%) f/u: 30 d Bundle: 21.5%; no bundle: 22.9%; $p = 0.1$; percent change: − 6.11%	No
Yu et al.[a] [111]; China; retrospective study	DBT + COPD discharge bundle ($n = 55$), DBT only ($n = 55$)	Hospital readmissions (%) f/u: 3 mo Bundle: 10.91%; no bundle: 27.27%; p = nr QoL: SGRQ score (mean, SD) f/u: 3 mo Bundle: 36.52, 17.61; no bundle: 45, 16.88; $p = 0.024$* BCKQ score (mean, SD) f/u: 3 mo Bundle: 34.65, 13.86; no bundle: 22.8, 13.24; $p < 0.05$* HADS (p value) f/u: 3 mo $p < 0.05$*	Yes
Zafar et al.[a] [112]; USA; BA	COPD care bundle ($n = 83$), no bundle period ($n = 50$)	ED revisit (%) f/u: 30 d Bundle: 30%; no bundle: 48.9%; $p = 0.003$* Rate of admissions to ED (admissions/month) Bundle: 12.7; no bundle: 15.8; $p = 0.16$	Yes

BA before-and-after study, *BCKQ* Bristol COPD Knowledge Questionnaire, *CCT* controlled clinical trial, *CI* confidence interval, *COPD* chronic obstructive pulmonary disease, *d* day(s), *DBT* diaphragmatic breathing training, *ED* emergency department, *f/u* follow-up, *HADS* Hospital Anxiety and Depression Scale, *HR* hazard ratio, *ITS* interrupted time series, *LoS* length of stay, *mo* month(s), *nr* not reported, *ns* not significant, *OR* odds ratio, *PCP* primary care physician, *QoL* quality of life, *RCT* randomised controlled trial, *SD* standard deviation, *SGRQ* St George's Respiratory Questionnaire, *yr* year(s)
*Statistically significant difference. [a]These studies were published after [24] and have, therefore, been added to the original table

and negative attitudes towards the implementation of new care bundles [117]. Staff may also be reluctant to engage with care bundles if there is a perception that this will be associated with an increase in workload, which may result in eligible patients not receiving the recommended care [116].

Lack of Knowledge and Experience

HCPs have reported that a lack of knowledge and experience with quality improvement initiatives is a key barrier to care bundle implementation [114, 118]. The need for appropriate education and training to elicit organisational change has also been highlighted [114, 118].

Appropriate Allocation of Tasks

HCPs in hospital and community settings have reported that it is sometimes unclear whose responsibility it is to carry out each element of the care bundle or that they do not understand the role that has been allocated to them. This can result in the roles required to deliver the care bundle not being fulfilled, resulting in a lack of continuity of care [117].

Complexity of the COPD Population

A recurring issue for HCPs is the complexity and heterogeneity of the COPD population resulting from variation in comorbidities, social circumstances and self-management behaviours [117, 118]. In particular, comorbidities were highlighted as an important challenge by clinicians responsible for patients with COPD because multiple discharge protocols may apply to a single patient [117].

Misdiagnosis of COPD

Misdiagnosis is common in COPD; previous studies have shown that 31–42% of patients regarded as having COPD did not meet the spirometric criteria for diagnosis [119–121]. This can lead to the unwarranted delivery of COPD care to misdiagnosed patients and a failure to deliver recommended care to patients with COPD who remain undiagnosed [118]. Providing care to misdiagnosed patients may increase the workload for HCPs and reduce the effect of care bundles on patient outcomes, which may have a detrimental impact on staff engagement.

LEARNINGS FROM CARE BUNDLES IN OTHER DISEASE AREAS

Although the literature for other disease areas also shows that uptake of new care processes can be challenging [122, 123], various studies have outlined different implementation strategies that could be applied to COPD. Here, we summarise three studies focused on HF, acute care in hospital and blunt chest injury, and describe their findings on the most effective care bundle implementation strategies.

Heart Failure

The Optimize Heart Failure Care programme is designed to improve outcomes following HF hospitalisation and has been implemented in 45 countries [124]. Several key factors to facilitate successful implementation included the involvement of a national or local HF group and/or a ‘local leader’ to create interest and to drive implementation across multiple hospitals [124]. Regular educational meetings for HCPs to raise awareness of the impact of HF interventions on hospitalisation and mortality, and to

encourage sharing of best practice, were also identified as potential facilitators of successful implementation. Other potential facilitators included multidisciplinary collaboration on programme implementation, including the involvement of specialist nurses and easy-to-use tools that are customised to local needs and languages [124].

Acute Care in Hospital

In their scoping review, Gilhooly et al. summarised studies describing the design, implementation and evaluation of care bundles in acute hospital care [125]. The most common strategies used to implement care bundles in acute hospital care included stakeholder education and training. Strategies that may facilitate successful bundle implementation and adherence included audit and provision of feedback, identification of barriers and facilitators, development of formal intervention blueprints, development of stakeholder relationships and staff champions [125].

Furthermore, the analysis demonstrated that the number and complexity of elements in a care bundle are negatively associated with bundle compliance; thus, care bundles with a small number of simple elements may increase compliance [125].

Blunt Chest Injury

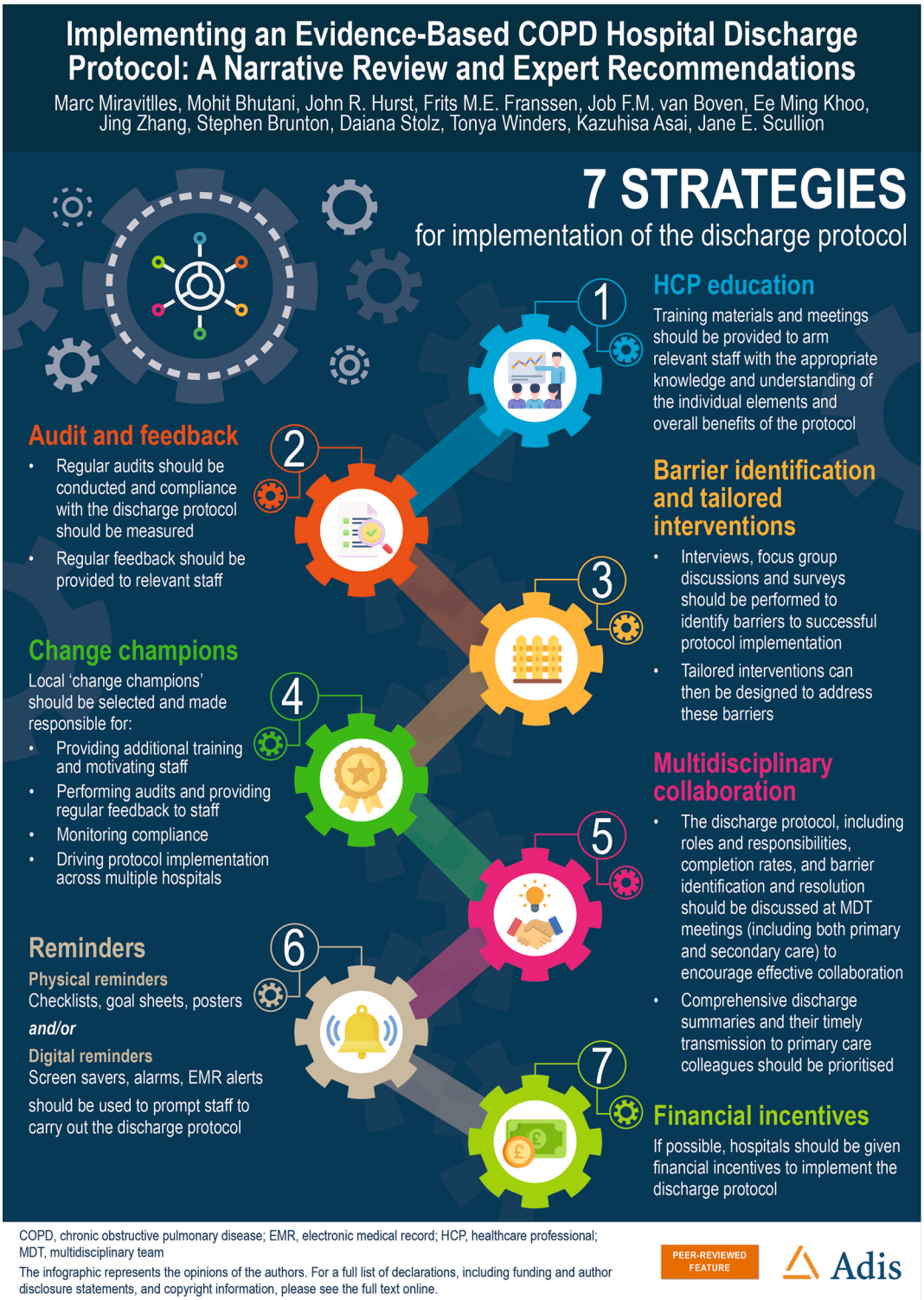
Kourouche et al. carried out a study to identify facilitators and barriers to the implementation of a blunt chest injury care bundle and to design strategies that promote future implementation [126]. Overarching principles to facilitate the implementation of a blunt chest injury care bundle included knowledge of evidence-based interventions and understanding of risk factors, confidence in physical skills required to implement the protocol (e.g. patient assessment and management) and professional responsibility towards patients [126]. Other facilitators of bundle implementation included positive beliefs about the impact of the care bundle on patient outcomes and the healthcare process, support for new protocols from colleagues as well as patients and their families, provision of training and a clear, succinct protocol [126].

Strategies selected to improve bundle implementation included a brief educational video to enable staff to implement the care bundle, face-to-face educational sessions on the roles and responsibilities of staff involved with implementing the care bundle, addition of an icon to the electronic medical record that allows activators of the care bundle to identify suitable patients to others, introduction of 'change champions' to provide training and additional support, and conducting audits and providing feedback to staff on the effectiveness of the care bundle [126].

RECOMMENDATIONS FOR IMPLEMENTING THE PROPOSED COPD HOSPITAL DISCHARGE PROTOCOL

Based on the learnings from previous implementation studies, seven key implementation strategies are recommended to promote the uptake of our proposed COPD discharge protocol. These are (1) HCP education, (2) audit and feedback, (3) barrier identification and tailored interventions, (4) change champions, (5) multidisciplinary collaboration, (6) reminders and (7) financial incentives (Supplementary Material).

Infographic



COPD, chronic obstructive pulmonary disease; EMR, electronic medical record; HCP, healthcare professional; MDT, multidisciplinary team

The infographic represents the opinions of the authors. For a full list of declarations, including funding and author disclosure statements, and copyright information, please see the full text online.

PEER-REVIEWED FEATURE

Adis

HCP Education

Members of staff who are involved in implementing the discharge protocol should be provided with the appropriate knowledge and evidence to ensure that they understand the individual elements and overall benefits of the protocol. Training on quality improvement initiatives should also be delivered to HCPs to address the reported lack of knowledge [114], preferably by a local champion who understands the setting and patient population. Education could be carried out through the distribution of printed or digital materials and face-to-face or virtual meetings, with the aim of providing staff with the knowledge, physical skills and confidence to implement the discharge protocol. 'Drop-in' sessions could be implemented where team members spend time on the ward to provide teaching on relevant topics and to promote the implementation of their discharge bundle without impeding clinical work [23].

Audit and Feedback

Regular and/or continuous audits should be conducted to obtain data on the effectiveness of the discharge protocol and to perform benchmarking between regions. A summary of 23 years of UK audits for hospitalised exacerbations showed that improvement in process indicators can be rapid when a continuous audit is combined with quality improvement support, and when these process indicators are linked to financial incentives [127]. Feedback should be provided to those using the discharge protocol to increase engagement and motivation. Compliance with the overall protocol, as well as with each individual element, should be monitored and communicated with the team [126]. To incentivise this implementation strategy, audits can be mandated through the reporting of non-performance to regulators. For example, in the UK, non-performance within the National Asthma and COPD Audit Programme is reported to the Quality Care Commission and must be included in a public document, the annual 'Trust Quality Account'. In addition, good performance can be rewarded; the national quality control programme in China provides those who perform well in audits with honorary certificates. Financial penalties could also be applied to incentivise auditing.

Barrier Identification and Tailored Interventions

If audits reveal poor discharge protocol uptake, barriers should be identified through interviews, focus group discussions or surveys of relevant staff members. Tailored interventions can then be designed to address the key challenges identified. For example, if staff engagement is identified as a local barrier to effective implementation of the care bundle, potential facilitators, such as finding project champions, delivering the bundle as a team, establishing financial incentives and prioritising the bundle as quality improvement, could be utilised, depending on the individual needs of the site and its staff [116]. Conversely, positive outcomes from successful regions can be used to identify best practices.

The provision of improvement tools, such as process charts, driver diagrams and frameworks for developing, testing and implementing changes, such as Plan-Do-Study-Act cycles, can be used to support local quality improvement [127].

Change Champions

Local 'change champions' should be selected and made responsible for providing additional training on the evidence base for the protocol and the practical skills required for implementation. Their role is to improve and disseminate beliefs around the purpose and effectiveness of the discharge protocol, leveraging existing stakeholder relationships to motivate staff. Additional responsibilities include providing feedback from audits to the relevant staff to increase engagement, monitoring compliance with the discharge protocol and driving implementation across multiple hospitals. Networks can allow change champions to pool resources

and report back to one another, discussing challenges and sharing key learnings.

Multidisciplinary Collaboration

The discharge protocol, including roles and responsibilities, completion rates, and barrier identification and resolution, should be discussed at multidisciplinary team (MDT) meetings to encourage effective collaboration and protocol implementation. Patients with complex needs (e.g. those with multiple comorbidities or challenging social circumstances) should be discussed at MDT meetings, and diagnoses and pharmacological regimens should be challenged if appropriate. Comprehensive discharge summaries and timely transmission of care should be made priorities to ensure effective communication and coordination between hospitals, primary care and community colleagues.

MDTs should comprise a variety of primary and secondary care HCPs with expertise in different fields; for example, pulmonologists, specialist nurses, clinical pharmacists, cardiologists, general practitioners and physiotherapists.

Reminders

Physical and/or digital reminders should be used to prompt staff to carry out the discharge protocol. Physical reminders could include checklists, goal sheets and posters, and digital reminders could include screen savers, alarms and electronic medical record alerts.

Financial Incentives

If possible, hospitals should be given financial incentives to implement the COPD discharge protocol. If there is a direct financial interest in doing so, providers may be more likely to allocate time to quality improvement initiatives. For example, the Commissioning for Quality and Innovation (CQUIN) incentive, introduced by the National Health Service in 2009, has been used to implement COPD care bundles in the UK. Consisting of financial incentives driven by targets, CQUIN incentives have been reported to be successful drivers for bundle uptake as they encourage managerial buy-in and allocation of resources to record and monitor bundle implementation [118]. Furthermore, a study of UK audits for hospitalised exacerbations demonstrated that process indicators were rapid when linked to financial incentives [127].

CONCLUSION

COPD discharge bundles can result in fewer hospital readmissions, lower risk of mortality and improved patient QoL. However, evidence for their effectiveness is inconsistent, and this is likely due to their variable content and implementation. Poor compliance with discharge bundles is challenging our ability to understand how discharge bundles affect clinical outcomes in COPD. Key barriers to care bundle implementation include resource constraints, lack of staff engagement, appropriate allocation of tasks, complexity of the COPD population and common misdiagnosis of COPD. However, these barriers can be addressed and applying key learnings on successful care bundle implementation from other disease areas may help to improve implementation of COPD discharge bundles. Further studies are required to assess the impact of COPD discharge bundles on patient outcomes and to identify the most (cost-) effective implementation strategies.

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