

Interventions to standardise hospital care at presentation, admission or discharge or to reduce unnecessary admissions or readmissions for patients with acute exacerbation of chronic obstructive pulmonary disease: a scoping review

Rachel MacDonell ,¹ Orla Woods,² Stephanie Whelan,² Breda Cushen,³ Aine Carroll,⁴ John Brennan,¹ Emer Kelly,⁵ Kenneth Bolger,⁶ Nora McNamara,⁶ Anne Lanigan,⁷ Timothy McDonnell,⁸ Lucia Prihodova²

To cite: MacDonell R, Woods O, Whelan S, *et al.* Interventions to standardise hospital care at presentation, admission or discharge or to reduce unnecessary admissions or readmissions for patients with acute exacerbation of chronic obstructive pulmonary disease: a scoping review. *BMJ Open Resp Res* 2020;**7**:e000733. doi:10.1136/bmjresp-2020-000733

► Additional material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjresp-2020-000733>).

Received 31 July 2020
Revised 1 October 2020
Accepted 8 November 2020



© Author(s) (or their employer(s)) 2020. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Rachel MacDonell;
rachelmacdonell@rcpi.ie

ABSTRACT

Introduction Chronic obstructive pulmonary disease (COPD) is a chronic respiratory disease that may be punctuated by episodes of worsening symptoms, called exacerbations. Acute exacerbations of COPD (AECOPD) are detrimental to clinical outcomes, reduce patient quality of life and often result in hospitalisation and cost for the health system. Improved diagnosis and management of COPD may reduce the incidence of hospitalisation and death among this population. This scoping review aims to identify improvement interventions designed to standardise the hospital care of patients with AECOPD at presentation, admission and discharge, and/or aim to reduce unnecessary admissions/readmissions.

Methods The review followed a published protocol based on methodology set out by Arksey and O'Malley and Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Electronic database searches for peer-reviewed primary evidence were conducted in Web of Science, EMBASE (Elsevier) and PubMed. Abstract, full-text screening and data extraction were completed independently by a panel of expert reviewers. Data on type of intervention, implementation supports and clinical outcomes were extracted. Findings were grouped by theme and are presented descriptively.

Results 21 articles met the inclusion criteria. Eight implemented a clinical intervention bundle at admission and/or discharge; six used a multidisciplinary care pathway; five used coordinated case management and two ran a health coaching intervention with patients.

Conclusion The findings indicate that when executed reliably, improvement initiatives are associated with positive outcomes, such as reduction in length of stay, readmissions or use of health resources. Most of the studies reported an improvement in staff compliance with the initiatives and in the patient's understanding of their disease. Implementation supports varied and included quality improvement methodology, multidisciplinary team engagement, staff education and development of written

Key messages

- What evidence is there for initiatives which aim to improve or standardise the acute care of patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) at presentation, admission or discharge, and/or aim to reduce unnecessary AECOPD admissions/readmissions?
- This scoping review consolidates the published evidence regarding hospital-based interventions which aim to standardise care at presentation, admission and/or discharge or to reduce unnecessary admission or readmissions for patients with AECOPD.
- This review provides a narrative synthesis of the evidence for front-line service providers, payers and planners designing improvement initiatives for AECOPD care and facilitates discussion of the implementation strategy and methods of support that will be necessary.

or in-person delivery of patient information. Consideration of the implementation strategy and methods of support will be necessary to enhance the likelihood of success in any future intervention.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common, preventable and treatable respiratory disease characterised by persistent respiratory symptoms.¹ Although misdiagnosis and underdiagnosis is common,²⁻⁴ it is estimated that worldwide prevalence of COPD has increased by 44.2% between 1990 and 2015, when the global prevalence was estimated to be 174.5 million



individuals.⁵ COPD is currently the third-leading cause of death globally.^{6,7}

The clinical course of COPD is punctuated by episodes of acute worsening of symptoms. These acute exacerbations of COPD (AECOPD) often require hospitalisation and are costly in terms of economics,^{8–10} lung health¹¹ and quality of life (QoL) for the patient¹² with heightened risk of readmission noted among patients with certain comorbidities and conditions, such as heart failure, renal failure, depression and alcohol use.¹³ Mortality rates of patients at 12 months postdischarge due to hospitalisation for AECOPD are over 20%.^{14,15} Huge variations in care have been noted within and between European countries with low adherence to clinical management recommendations.¹⁶ The need to reduce COPD exacerbations and hospitalisations has been recognised by guideline development bodies, researchers and clinicians,¹⁷ with international consensus guidelines calling for implementation of evidence-based approaches for improved COPD diagnosis and management.¹⁸ WHO ‘25 by 25 goal’ aims to reduce global deaths from COPD by 25% by 2025.¹⁹

The purpose of this review is to identify initiatives which aim to improve standardise hospital-based care of AECOPD patients at presentation, admission or discharge, and/or aim to reduce unnecessary AECOPD admissions/readmissions. These findings will assist in the design of a national AECOPD initiative which has been commissioned to standardise AECOPD acute, hospital-based care across Ireland.

METHODS

Scoping reviews are a type of knowledge synthesis which present a broad overview of the available evidence, irrespective of study quality.²⁰ Scoping reviews are useful to clarify key concepts and identify gaps when examining emerging areas,²¹ and as such was deemed an appropriate methodology for this review. The protocol for this scoping review, based on the methodological framework proposed by Arksey and O’Malley²² and Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines,²³ has previously been published.²⁴

Identifying relevant studies

A search was undertaken for COPD studies relating to acute hospital-based care presentation, admission and discharge interventions as well as interventions aiming to reduce COPD admission(s) or readmission(s). English language, peer-reviewed studies published between January 2000 and September 2020 in the Web of Science, Embase (Elsevier) and PubMed electronic databases were included. A rapid scoping review undertaken in 2017 by this research team detected no relevant results between 1990 and 2000. Examples of specific search terms used include ‘COPD, intervention, quality improvement (QI), acute care, admission avoidance, prevention of readmission, admission and discharge bundles, care pathways’. A full list of search terms is contained in online supplemental materials. The participants/population, intervention(s), context and outcomes (PICO) for this review are presented in [table 1](#) below.

Study selection

Relevant articles were screened as previously described.²⁴ RM, LP and OW conducted independent title reviews against PICO criteria. All authors participated in abstract and full-text review. Any inclusion/exclusion discrepancies were resolved by discussion and consensus between RM, OW and SW. Eligibility criteria are listed in [table 2](#). Studies were included where endpoints were described.

Data extraction

Two researchers (RM and LP) designed a standardised Microsoft Excel datasheet for data extraction which was validated (RM and OW) using two randomly selected articles from the search results. Data items were extracted from each paper using the headings described previously²⁴; study descriptors, study design, intervention descriptors, measures, results, discussion and reviewer’s appraisal.

Patient and public involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

Table 1 PICO terms

Participants/population	Patients with AECOPD
Intervention	Intervention or improvement related to AECOPD model of care, or care pathway, or care management at presentation, admission or discharge
Context	Acute hospital setting or service delivery by acute healthcare team
Outcomes	Standardisation of admission or discharge processes or reduction of unnecessary admissions/readmissions

AECOPD, acute exacerbations of chronic obstructive pulmonary disease; PICO, population, intervention(s), context and outcomes.

Table 2 Review inclusion/exclusion criteria

Criteria for inclusion	Criteria for exclusion
<ul style="list-style-type: none"> ▶ Peer-reviewed, primary evidence, journal articles, published between 1 January 2000 and 20 September 2020, English only. ▶ Concerning adults with COPD. ▶ Introduced an original (or adapted) explicit intervention or implementation strategy to improve care in AECOPD with the aim of standardising care (at presentation, admission and/or discharge) or reducing unnecessary admissions or readmissions to acute secondary care. ▶ Included a detailed description and explanation of the intervention or implementation strategy. ▶ Intervention(s) applied in an acute healthcare setting, for example, hospital or acute healthcare team. ▶ Aimed to improve outcomes in admission rates, admission avoidance, length of stay, readmission rates or time to care. 	<ul style="list-style-type: none"> ▶ Studies not meeting the inclusion criteria. ▶ Studies which primarily refer to aetiology, physiology, environmental factors, medical treatment (including pharmacology). ▶ Studies which primarily examine predictive modelling, risk assessment, economic burden or cost savings at societal level. ▶ Studies which do not present an intervention or implementation strategy. ▶ Studies using secondary data.

COPD, chronic obstructive pulmonary disease.

RESULTS

Of the total 1922 records, after removal of duplicates (n=324), 1466 were removed following abstract screening, with a further 111 removed at full-text screening, resulting in 21 articles included for analysis (figure 1).

Implementation strategies reported in included studies focused on training and education of healthcare professionals (n=11) and patients with AECOPD (n=15). Some studies engaged multidisciplinary teams (MDT) to support change implementation (n=13) or used named champions/coordinators to disseminate the change/change message (n=11).

Most of the studies reported positive trends, with some showing significant change and others non-significant, in primary outcome such as intervention compliance (n=11), reduced length of stay (LOS) (n=4) or reduced readmissions (n=7). Other improvements included reduced mortality (n=3) and improved QoL for

patients (n=4). Table 3 summarises the included paper characteristics.

Intervention methods

A variety of methods, implementation strategies and supports were used to improve AECOPD care, demonstrating varying levels of success. Content analysis of the final 21 articles identified four intervention types that were used to impact care at presentation/admission or discharge, or both, for patients with AECOPD. These are (1) clinical care bundles (n=8; defined as groups of improvement interventions which are implemented together²⁵), (2) care pathways (n=6; defined as written or computer-based systems which support clinical decision making and the organisation of care processes for patients²⁶), (3) coordinated case management (n=5 defined as a process in which a designated person

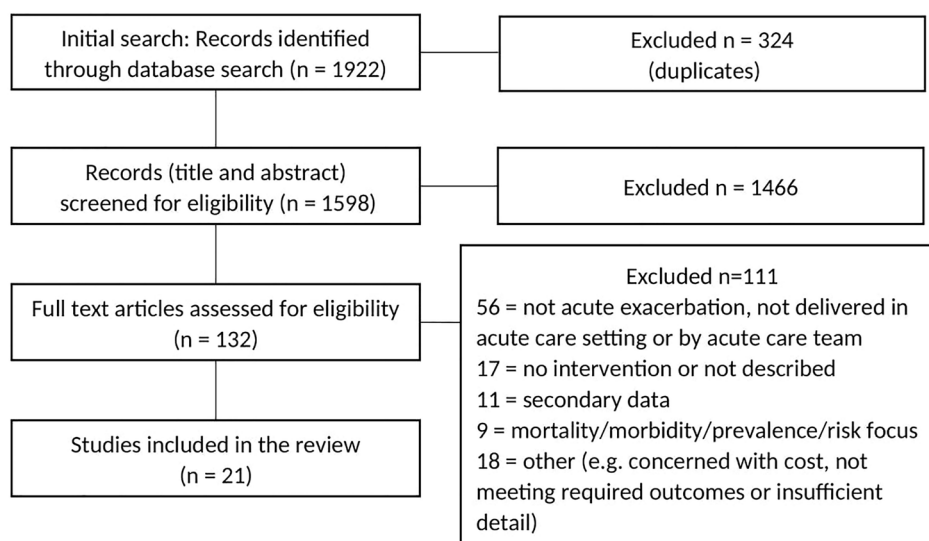


Figure 1 Scoping review process.

Table 3 Study characteristics by intervention type

Intervention type	First author	Year	Location	Study type	Aim	Setting	Participants	Sample size	COPD disease stage
Care bundle	Lavery ³²	2011	UK	Quality Improvement report	To develop and pilot the implementation of a COPD discharge care bundle	Respiratory ward in a city hospital (England)	Patients admitted with AECOPD	94 patients	Not described
	Miller ³⁰	2013	Ireland	Feasibility study	To determine the efficacy and usefulness of a COPD care bundle designed for the initial management of AECOPD and to assess whether it improves quality of care and provides better outcomes	Emergency department (ED) in a university teaching hospital	Patients presenting to ED with AECOPD	101 patients (50 pre, 51 post)	Not described
	Zafar ³³	2015	UK	Interrupted time series analysis	To evaluate (1) the impact of implementing a care bundle on AECOPD readmissions and (2) number of bed days occupied at hospitals using the care bundle	Nine NHS acute hospitals across three trusts (England)	AECOPD admissions aged ≤45 years	9 hospitals	Not described
	Pendharkar ³⁶	2015	UK	Quality Improvement project	To improve compliance with the British Thoracic Society guidelines and Commissioning for Quality and Innovation scheme for patients admitted with AECOPD	Unscheduled care setting in one hospital	Front-line medical teams in unscheduled care of COPD patients plus nursing support	Described as small	Not described
	Morton ³⁵	2017	USA	Quasi-experimental study and 'model for improvement'	Reduce 30-day all-cause readmissions by (1) creating a COPD care bundle that addresses care delivery failures, (2) using improvement science to achieve 90% bundle adherence	800-bed, academic (hospital) health centre (regional referral hospital; USA)	AECOPD (documented, clinical diagnosis)	207 admissions	Not described
	Epstein ³⁴	2018	Canada	Analysis of administrative health data for a quality improvement project	To determine whether the implementation of an evidence-based computerised admission order set would improve the quality of inpatient AECOPD care	Large, tertiary care teaching hospital	Patients with AECOPD	1413 patients with a LOS less than 90 days	Not described
	Santamaria ⁴⁰	2019	UK	Mixed-methods, controlled before- and-after study with nested case studies	To evaluate the effectiveness of introducing admission and discharge care bundles for patients with an AECOPD as a means of improving hospital care, and reducing readmissions and mortality, and to explore the impact on cost of care	19 acute hospitals in England and Wales	All COPD admissions	4657 admissions	Not described
	McManus ⁴¹	2019	Israel	Pragmatic study (pre- and post-intervention study)	To evaluate the effect of this tool on rates of adherence to published guidelines	A 1000-bed academic hospital serving over 2 million residents in northern Israel	Patients with AECOPD	367 patients received the intervention	Not described

Continued

Table 3 Continued

Intervention type	First author	Year	Location	Study type	Aim	Setting	Participants	Sample size	COPD disease stage
Care pathway	Nishimura ⁴²	2004	Australia	Prospective cohort study (group design)	To compare the clinical and functional outcomes of patients with an AECOPD treated with standard care to those treated with a clinical pathway	A large regional referral centre	Patients who were hospitalised and who were treated according to the clinical pathway for AECOPD	178 patients (88 intervention, 90 standard care)	Not described
	Bar ³⁷	2005	Northern Ireland	Prospective study	To ensure delivery of evidence-based practice, optimised care, reduced LOS and reduced mortality through implementation of a care pathway	An inner-city area district general hospital recognised for its social deprivation	Patients with AECOPD	85 patients	Not described
	Vanhaecht ³⁸	2011	Japan	Prospective observation (5 years)	To evaluate the outcomes of patients hospitalised with AECOPD in Japan, treated with a clinical pathway following published guidelines	An urban general hospital	Patients who were hospitalised and treated according to the clinical pathway for AECOPD	276 hospitalisations of 165 patients	Stage I, II, III and IV COPD
	Ohar ³⁹	2012	Malaysia	Non-randomised prospective study with historical controls	To evaluate the effectiveness of implementation of a care pathway for AECOPD	An urban university medical centre	Patients admitted with AECOPD	193 patients (95 intervention, 98 historical control)	Stage II, III and IV COPD
	Garcia-Aymerich ⁴³	2016	Belgium, Italy, Portugal	International cluster randomised controlled trial	To evaluate whether implementation of a care pathway for COPD improves the 6 months readmission rate	Twenty-two hospitals	Patients admitted with AECOPD	342 patients (174 intervention, 168 control)	GOLD I - IV (mild - very severe)
	Abad-Corpa ⁴⁴	2018	USA	Retrospective, electronic health record based, observational cohort study	To evaluate the efficacy of an AECOPD Care plan programme	Medicare single site hospital	Patients admitted with AECOPD	1274 index admissions	Not described

Continued

Table 3 Continued

Intervention type	First author	Year	Location	Study type	Aim	Setting	Participants	Sample size	COPD disease stage
Coordinated Lainscakcase management	Moulic ⁴⁵	2007	Spain	Randomised controlled trial	To assess the effectiveness of an integrated care intervention at discharge	One urban tertiary hospital	Patients recently discharged after AECOPD	113 exacerbated COPD patients	Mostly severe COPD
	Lainscak ⁴⁶	2012	Spain	Quasi-experimental design	To evaluate the effectiveness of protocol intervention for hospital discharge and follow-up in the primary care of patients with COPD	Two university tertiary-level public hospitals and their related local primary healthcare centres	Patients admitted into hospital with a main diagnosis of COPD	143 participants (56 intervention, 87 control)	Not described
	Gay ⁴⁷	2012	Canada	Retrospective, longitudinal cohort study	To provide empirical evidence in support of this framework, by evaluating the effect of a well-defined IC intervention on healthcare utilisation in stable COPD patients ³⁹	One urban and one suburban hospital	Patients with a primary diagnosis of COPD and a history of hospitalisations of at least 48 hours duration, due to exacerbations	189 patients in total (96/576 in the urban hospital, 93/279 in the suburban)	Mostly moderate to severe COPD
	Wang ⁴⁸	2013	Slovenia	Randomised controlled trial	To test whether coordination of discharge from hospital and postdischarge care reduces hospitalisations in patients with COPD	Specialised pulmonary hospital	Admitted with AECOPD, with reduced pulmonary function	253 patients (118 intervention, 135 usual care)	Mostly severe COPD
	Benzo ⁴⁹	2019		Pilot study (quality project)	To improve the quality of care for patients with COPD and reduce readmissions	Large urban teaching hospital	Patients admitted with AECOPD	157 patients	Not described
Health coaching	Horner ²⁵	2014	China	Randomised controlled trial	To test the effect of a Health Belief Model-based nursing intervention on healthcare outcomes in Chinese patients with moderate to severe COPD	Respiratory ward in a university general hospital	Patients with moderate to severe COPD admitted to the respiratory ward	92 patients (45 intervention, 47 control)	Moderate to severe COPD
	Schrijvers ²⁶	2016	USA	Randomised controlled trial	To determine the effect of comprehensive health coaching on the rate of COPD readmissions	Two hospitals	Patients admitted with AECOPD	215 patients (108 intervention, 107 control)	Not described

AECOPD, acute exacerbations of chronic obstructive pulmonary disease; LOS, length of stay; NHS, National Health Service.

supports the coordination, integration and management of a patient's health and social care needs²⁷) and (4) health coaching (n=2; defined as a patient-centred partnership between patient and trained coach where patients are encouraged to determine their personal health goals and increase knowledge and confidence in their own ability to manage their condition²⁸). Methodologies applied are presented in table 4.

Care bundles

Implementation of, or improved compliance with, AECOPD care bundles was the focus of eight studies. Of these, two were aimed at presentation or admission,^{29 30} four introduced a discharge bundle,^{31–34} one implemented both an admission and discharge bundle³⁵ and one described an end-to-end bundle covering care from presentation through to discharge.³⁶

Presentation/admission bundles

Of the three articles concerned with a presentation or admission bundle, one used an MDT designed 10-step bundle²⁹ and the other two used existing BTS guidelines.^{30 35} McCarthy *et al* found that staff education improved compliance significantly from a mean of 4.6–7 elements completed but without significant reduction in the 30-day readmission rate or median LOS.²⁹ Two studies employed QI methods^{30 35} with one reporting increased adherence from 63% to 77% in 2 months, remaining above 70% for the next 4 months.³⁰ Success was attributed to multiple communication strategies to raise the profile of the bundle, such as posters, emails and engagement meetings. In the other paper, training, networking and mentoring resulted in staff rating the use of bundles positively, although no improvement in readmission or emergency department (ED) presentation rates occurred.³⁵

Discharge bundles

Hopkinson *et al* detailed the development and implementation of a COPD discharge care bundle,³¹ which was later spread to nine acute hospitals across England.³² These studies used QI tools and methodologies such as process mapping, stakeholder engagement and rapid-cycle plan-do-study-act (PDSA) testing. Both also engaged the MDT (ward nurses, physiotherapists, clinical nurse specialists and doctors) in activities including education meetings, information stands, daily pharmacist teaching, aide-mémoire development, weekly check-ins with staff and performance-related prizes to improve bundle awareness and compliance. The initial hospital study saw increased compliance with regard to referrals to smoking cessation services and pulmonary rehabilitation sessions, self-management plan provision and medication review.³¹ Thirty-day readmissions saw a non-significant reduction from 16.4% to 10.8%. In the follow-on study, results showed a similar non-significant reduction in the 28-day readmission rate; while within the readmission group, a

further, non-significant reduced LOS of 2 days was noted in the intervention group.³²

Using QI methods including multiple PDSA tests with staff and patient feedback, and a redesigned patient pathway to standardise care processes, improve discharge planning and give healthcare professionals greater role clarity, Zafar *et al* noted that bundle compliance increased to 90%.³³

Epstein *et al* integrated a clinical decision support tool with an existing electronic healthcare record to improve clinician adherence to AECOPD discharge recommendations.³⁴ As a result, more patients were discharged with the correct recommendations (80.47% vs 25.37%). Patients were far more likely to receive prescribed medication within 60 days of discharge (54% vs 20%) and demonstrated increased vaccine uptake (92% vs 13%), while follow-up visits were provided to nearly 98% of patients.

End-to-end bundle

Pendharkar *et al* held engagement meetings and initiated a new Computerised Physician Order Entry (CPOE) for AECOPD in a large, tertiary care teaching hospital.³⁶ The bundle included elements for tests, medications, consultations and discharge planning with key elements prechecked and was implemented with different hospital physician groups (hospitalist, general internist or respiratory specialist) admitting AECOPD patients. Though the voluntary CPOE was used by the physicians less frequently than anticipated, when it was used LOS was reduced by 1.15–1.8 days. Importantly, readmission rates did not increase, indicating that earlier discharge did not have a negative impact on the safety of patients at home.

Care pathways

Six studies introduced or evaluated an AECOPD care pathway. All interventions were MDT-designed and implemented; with three employing a designated coordinator.^{37–39} All included criteria for investigations, treatment interventions, consultations with multiple support disciplines (eg, physiotherapy) and discharge planning. Patient education was an additional priority in four studies.^{38 40–42} Implementation supports included time and discipline specific prompts,⁴⁰ a scoring system to aid in decision making around admission need,⁴¹ a printed flowsheet to identify sequential treatment steps⁴² or coordinated clinical audit, workshops, teaching sessions and meetings with pathway facilitators.³⁸ LOS was frequently measured and results varied from no change³⁸ to a non-significant 0.89-day improvement⁴⁰ to significant reductions of 2 days³⁷ and 4 days.⁴¹ Impact on readmission rate, if recorded as a primary outcome, varied between studies. McManus *et al* noted that their score-based admission decision model was associated with a 4% drop in 1-month readmission rate and a 57% reduction in-hospital mortality.⁴¹ Vanhaecht *et al* recorded a significantly reduced readmission rate of 27.3% (down from

Table 4 Data synthesis arranged by PICO criteria: intervention, context and outcome for patients with AECOPD

Intervention type	
Stage of AECOPD Care Pathway Impacted	Care bundle (eight articles)
	Presentation ^{29 30 36} Admission ^{30 35} Discharge ^{31–34} Presentation through to discharge ³⁶
	Admission through to discharge ^{37–42}
	Multidisciplinary team design ^{29–33 35} Initial assessment or investigation ^{29 30 35 36} Initial treatment or medication ^{29 30 34–36} Respiratory specialist consultation ^{29–31 35 36} Patient education ^{31–33} Discharge planning ^{31–33 35 36} Specialist service referral (eg, smoking cessation, occupational therapy) ^{29 31–36} Follow-up plan ^{31–35}
	Admission through to discharge ^{37–42}
	Multidisciplinary team design ^{37 40–42 44} Assessment/investigation at presentation ⁴⁰ Assessment/investigation at admission ^{37 39 41} Initial or ongoing treatment/medication prompts ^{37 38 40–42} Patient education ^{38 40–42} Specialist service referral (eg, smoking cessation, occupational therapy) ^{37–42} Discharge planning ^{38–40 42} Postdischarge planning (hospice/palliative care) ³⁹ Nursing ^{37 38 40–42} Physiotherapy ^{37 38 40–42} Medicine ^{37 38 40–42} Pharmacy ⁴² Nutrition/dietician ^{37 42} Social work ^{37 40} Occupational therapy ^{37 40 41} Palliative care ³⁹
	Admission through to discharge ^{43–45}
	Inpatient specialist visits ^{44–47} Patient education ^{43–46} Self-management strategies ^{43 45} Postdischarge home visit ^{43 44} Patient needs analysis ^{43 44 46} Liaison with other specialists ^{43–47} Ongoing telephone support ^{44–47} Call centre support ^{43 45}
	Inpatient specialist visits ^{48 49} Patient education ^{48 49} Written information ^{48 49} Personal health goals ⁴⁹ Self-management strategies (incl. exercise) ^{48 49} Postdischarge home visit ⁴⁹ Ongoing telephone support ^{48 49}
	Admission through to discharge ^{48 49}
	Designated coordinator (nurse or other) ^{43–47} Primary care team (medical and nursing) ^{43 44 46} Social work ⁴⁶
	Designated health coach ^{48 49} Nurse specialist ^{48 49} Respiratory therapist ⁴⁹
Key disciplines involved in implementation	Nursing ^{29–31} Physiotherapy ³¹ Medicine ^{30 31 33 34 36} Pharmacy ^{31 33}

Continued

Table 4 Continued

	Intervention type			
Methodology and supports for implementation	Model for Improvement (Quality Improvement) ^{30,31,33,35} Audit ^{29,30,36} Focus group/workshop/interview ^{30,31,33,35} Patient input ^{31,33,35} Staff education ^{29-31,35,36} Posters ³⁰ Email reminders ³⁰ Worksheet/pack ^{30,31} Pre-checked forms ^{34,36} Staff "champion" ³⁰ Staff feedback/survey ^{30,31,33} Commissioning incentives ^{30,32} Inbuilt electronic system ^{33,34,36} Awards/prizes ³¹	Model for Improvement (Quality Improvement) ³⁸ Audit ^{38,41} Focus group/workshop ^{38,41} Designated coordinator ^{37-39,41} Staff education ^{37,38,41} Discipline specific responsibilities ^{37,40} Daily checks to identify patients ³⁷ Launch/promotion ³⁷ Peer to peer support ³⁷ Worksheet/pack ^{39,42}	Specific training ⁴³ Dedicated case management role ^{43,45,46} Patient/family engagement ^{46,47}	Specific training ^{48,49} Supervision ⁴⁹ Coaching session evaluation ⁴⁹
Key outcomes measured	Bundle adherence ^{29-34,36} Length of stay ^{32,33,36} Readmission rate ^{29,31-33,36} Emergency department presentations ³⁶	Pathway adherence ^{38,39,41,42} Length of stay ^{37,38,40,41} Readmission rate ³⁷⁻⁴⁰ Complication rate ^{37,40} Mortality ^{37-39,41,42}	Emergency department presentations ^{45,47} Readmission rate ⁴³⁻⁴⁷ Quality of life ^{43,44,46} Patient satisfaction ⁴⁴ Level of knowledge ⁴⁴ Mortality ⁴⁶ Length of stay ⁴⁵	Readmission rate ⁴⁹ Quality of life ⁴⁹ Physical activity ^{48,49} Health belief ⁴⁸ Self-efficacy ⁴⁸ Dyspnoea scores ⁴⁸

Some articles contain multiple PICO criteria in each category. AECOPD, acute exacerbations of chronic obstructive pulmonary disease; PICO, population, intervention(s), context and outcomes.



33%) at 30 days.³⁸ In the study conducted by Ban *et al*, a longer time between admissions was observed, although no significant reduction in readmission occurred.³⁷ Additional improvements were recorded in several studies, including adherence to key clinical interventions,^{38 39 41 42} improved confidence of ward staff after education regarding inhaler technique, smoking cessation and pulmonary rehabilitation,³¹ improved teamwork or communication^{40 41} and a positive impact on patient perception of their ability to self-manage their disease.⁴⁰

Coordinated case management

Five studies implemented coordinated care for AECOPD discharge and follow-up.^{43–47} All interventions were coordinated by a designated individual, with specific training support for that role described in one.⁴³ Case management was activated from admission^{46 47} or in preparation for discharge^{43–45} and all coordinated care following discharge.^{43–46} Case management interventions comprised in-hospital patient education visits,^{43–46} person-centred needs analysis^{43 44 46} and self-management strategy discussion.^{43 45} Key features of the postdischarge support included ongoing liaison with other specialists from acute,⁴⁷ primary and community care,^{43–46} follow-up telephone support^{44–47} and dedicated telephone support for families or primary care providers.^{43 45}

Moullec *et al* reported a patient-centred intervention that provided 3-hour-long self-management education sessions and ongoing case management which resulted in significantly reduced COPD-related hospitalisations over 12 months (−0.5 admissions/patient/year).⁴⁵ ED presentations were not impacted but LOS was reduced from 4.0 to 3.5 days. Garcia-Aymerich *et al* conducted a 9-month nurse-led integrated care intervention comprising a comprehensive patient assessment and education session at discharge, development of an individually tailored plan for MDT care and ongoing telephone support.⁴³ Patients demonstrated heightened disease knowledge, treatment adherence, nutritional status and self-management ratings.

In the study by Abad-Corpa *et al*, care was coordinated by two trained nurses who conducted five daily visits to eligible admitted patients to provide disease specific information, identify patient needs and liaise with other professionals, such as primary care, in preparation for discharge.⁴⁴ Patient reported QoL significantly improved at 12 and 24 weeks after discharge, as did their level of knowledge about COPD. A non-significant 4% reduction in readmission rate was detected.

The discharge coordinator role presented by Lainscak *et al* actively involved patients and caregivers in discharge planning and communicated with community/home care services before discharge.⁴⁶ In the inpatient setting, the coordinator assessed individual patient clinical and homecare needs to identify any problems and adjust in-hospital interventions. After discharge, they contacted patients by phone within 48 hours and performed a

home visit after 7–10 days, while liaising with community services. Significantly fewer readmissions occurred in the intervention group (14% vs 31%).

In 2019, Gay *et al* reported on a pilot quality project which aimed to standardise the care provided to high risk, admitted COPD patients using automated specialist referrals, treatment checklists and coordinated care post-discharge.⁴⁷ Though no improvement was found in readmissions or emergency room visits in the intervention arm, more patients attended a pulmonary follow-up visit within a month of discharge (39% vs 16%), while rates of referral to palliative care services increased with twice as many referrals to palliation in the intervention arm.

Health coaching

Two articles explored the implementation of AECOPD health coaching interventions.^{48 49} Both involved a dedicated coach who developed a partnership with patients during admission and after discharge. Education about disease management and personal health goal setting were key elements of both interventions. Wang *et al* indicated that levels of self-belief, self-efficacy and lung function improved over the duration of the intervention.⁴⁸ Benzo *et al* reported a significant effect on rates of COPD hospitalisation at 1, 3 and 6 months posthospital discharge, while a significant and sustained beneficial impact on disease-specific, health-related QoL at 6 and 12 months postdischarge was observed.⁴⁹ Health coaching was presented as an easily trainable and versatile intervention that can be applied to many chronic conditions.⁴⁹ Both papers found their intervention increased patient confidence and their ability to manage their own conditions.

DISCUSSION

This scoping review consolidates the published evidence regarding interventions which aim to standardise care at presentation, admission and/or discharge or to reduce unnecessary admission or readmissions for patients with AECOPD. Four main intervention types were identified in the 21 studies; (1) care bundles, (2) care pathways, (3) coordinated case management and (4) health coaching interventions. Different methods of implementation were used, and varying degrees of improvement or impact were reported; with reduced LOS and readmission rate key study endpoints. Each intervention type presented opportunities for standardisation of care and MDT input, although some relied on a dedicated individual/role to encourage compliance with the intervention.

Care bundles

AECOPD care bundles were tested at presentation/admission or discharge. Paper-based^{29 30 33} or electronic format^{33 36} bundles were promoted to enhance standardisation of care, boost adherence to guidelines and allow opportunities to identify and rectify missed elements

of care.²⁹ QI methodology, such as stakeholder engagement and iterative service redesign and testing, was used effectively to increase adherence to bundle interventions through engagement with front-line clinicians, raising awareness and understanding of the use of care bundles.^{30 33} Increased compliance with bundle elements was associated with reduced LOS³⁶ and reduced hospital readmissions.^{30 33}

Morton *et al* paper noted that although clinical outcomes were not significantly improved, staff perceptions of care bundles were largely positive.³⁵ Bundles were described a useful for standardisation of care, providing clarity around the patient pathway, facilitating effective interdisciplinary communication and identifying post-discharge support needs.⁵⁰ A recently published meta-analysis of 37 studies looking at bundle implementation for treatment of various conditions echoes Morton *et al*'s findings of low-quality evidence, though still concluding that the implementation of care bundles may be an effective strategy to improve patient outcomes when compared with usual care.⁵¹

Epstein *et al* propose several key features of their tool that others might model for success including user-friendly design with prepopulation according to evidence-based guidelines, seamless integration into existing electronic resources and provision of clinical decision support to help clinicians under pressure.³⁴ This marries well with the advice published in a 2020 review article discussing models of care in COPD; discharge bundles should be well defined, tailored to the support needs of an individual, and should be suitable for the context.⁵⁰

Overall, the evidence from this review indicates that implementation of care bundles can help to ensure commonly missed elements of care are no longer missed and may enhance compliance with evidence-based treatments for AECOPD.²⁹ Involvement of those responsible for enacting the change was found to support implementation with stakeholder meeting engagements,³⁰ education sessions^{30 35} end-user feedback^{30 33} and mixed communication methods²⁹ all contributing to improved implementation. Additional supports such as electronic prompts and prefilled templates^{30 33 34} were found to be helpful, as was nominating champions³⁰ or offering rewards for bundle compliance.³¹ Patient input helped teams to understand their systems and to shape implementation in some settings. Intense bundle 'marketing' may also be associated with increased bundle compliance.³⁰ Methods which use these strategies to influence behaviour change and support the implementation of care bundles should be considered by intervention teams.

Care pathways

All six care pathway interventions included MDT design and delivery, and all commenced from admission. All studies incorporated strategies for improved discharge planning and one specified the provision of postdischarge telephone follow-up.³⁹ Four pathways included in-hospital

patient education elements, with three conducting introductory training sessions for staff.^{37 38} Four pathways were overseen by a dedicated coordinator^{37-39 41} with the other two relying on MDT clinicians to implement the pathway.^{40 42}

Implementation supports were not described in as much detail as those described in the care bundle studies. Vanhaecht *et al* used QI methods and an audit-feedback approach to help hospital teams to understand care processes within their setting, to identify gaps in care and to generate plans for improvement.³⁸ Audit was also used by McManus *et al*.⁴¹ The designated coordinator role aided pathway compliance,^{37 39 41} however, difficulties arose if an AECOPD admission was not identified, and therefore, did not receive standardised care.^{39 42}

Two papers noted attributed enhanced teamwork practices and reduced patient anxiety to implementation of the care pathway.^{40 41} Elsewhere, hospital culture and context has been linked to the likelihood of implementation success,⁵² improvement in care pathway processes and improved teamwork or team climate.⁵³ There is a staffing resource implication for implementing a coordinated care pathway which may need to be considered against the degree of quantifiable benefits for clinicians and patients such as potential decreased hospitalisation costs.

Coordinated case management

The five coordinated case management interventions commence at AECOPD admission to help preparation for discharge and beyond.⁴³⁻⁴⁷ Interventions comprised individualised education sessions,⁴³⁻⁴⁶ self-management strategies^{43 45} and personalised case management including liaison with other services, such as social^{46 47} or palliative care⁴⁷ and patient follow-up for between 6 and 12 months after discharge.^{44 46} Importantly, a focus on patient education and promotion of self-management strategies appeared to increase patient understanding of their disease,⁴³ improve QoL⁴⁴ and positively impact overall mortality.⁴⁶

Studies presented elsewhere agree; coordinated case management can provide well-defined, integrated/shared-care arrangements between levels of care⁴³ that are sustainable, person-centred and have the potential to reduce LOS⁵⁴ readmission rates,^{55 56} mortality⁵⁷ and healthcare costs.^{54 55} Like the care pathways, case management interventions were found to be context-dependent, requiring a tailored approach in any setting⁵⁴ and should take account of individual patient needs.⁵⁰ Although there are benefits to the utilisation of a designated case coordinator, the resource requirement for this type of intervention may not be feasibly replicated in other healthcare settings.

Health coaching

As with the integrated case management model, health coaching can be resource intensive⁴⁸ due to the

requirement for a dedicated, trained staff member to implement the intervention.^{37 48} Benefits include versatility in design as it is delivered onsite during admission and thereafter, by telephone.⁴⁹ However, patients' feelings of attention and support from the health coach may influence outcomes.⁴⁸ Further, due to the multicomponent nature of the comprehensive health coaching intervention tested, the exact contributory effect of each individual component of the intervention is difficult to establish.⁴⁹ Supervision of coaching sessions and use of a checklist to evaluate session content may provide support and feedback to the health coach.⁴⁹

AECOPD interventions

The intervention types discussed use a variety of different methodologies, with the global aim of improving AECOPD care at various stages of the AECOPD in-patient journey. Reliance on a dedicated resource may not be replicable across healthcare jurisdictions with different funding models or patient populations spanning socio-demographic boundaries. However, the benefits of investing in the standardisation of care and reducing unnecessary readmissions cannot be underestimated given the economic burden of COPD hospitalisation and impact on patient QoL. Care bundles and care pathways, when reliably implemented, have been shown to standardise care and improve care outcomes for patients with AECOPD^{29–42} and other chronic conditions or clinical situations.^{51–53} Similarly, interventions overseen by a dedicated coordinator role, whether as case manager or health coach, have had positive impact on care standardisation,⁴⁷ LOS,⁴⁵ readmission rate,^{43–46 49} and QoL,^{43 44 46 49} self-belief⁴⁸ or satisfaction.⁴⁴ The use of implementation strategies that incorporate MDT engagement and end-user education while taking account of contextual factors to enhance suitability of the intervention to the

service is strongly advised. Figure 2 graphically represents these implementation supports as reported for each intervention type.

STRENGTHS AND LIMITATIONS

This scoping review provides a timely summary of peer-reviewed evidence of interventions used to improve or standardise care for patients with AECOPD. Rigorous methodology was used to design, conduct and report the findings of the review. However, at the time of data extraction, little published research existed for pathway improvement interventions for AECOPD and of those, implementation methodology and outcomes were not described in granular detail, limiting the possibility of in-depth analysis. Although the variability in definition of severity of COPD exacerbation between studies is acknowledged, because the focus of this review was on the intervention being studied our findings may be generalisable to the target population. A narrow focus in the search criteria limited the number of eligible papers; geographical variation in provision of Hospital at Home and Early Discharge Support services in Ireland precluded these initiatives for review and lack of resources prevented inclusion of studies published in other languages which may have resulted in missed papers. The evidence for change in the eligible papers was further limited by small sample sizes, poor compliance with the intervention and non-statistically significant findings. In addition, sustainability of results may be contingent on the continuation of supports and active coordination of the intervention. Most studies tended not to include economic impact of the intervention although Morton *et al* found no evidence for cost savings after bundle implementation.³⁵ Others noted potential for cost savings through reduced LOS⁴⁰ or readmissions.⁴⁸ Future studies are

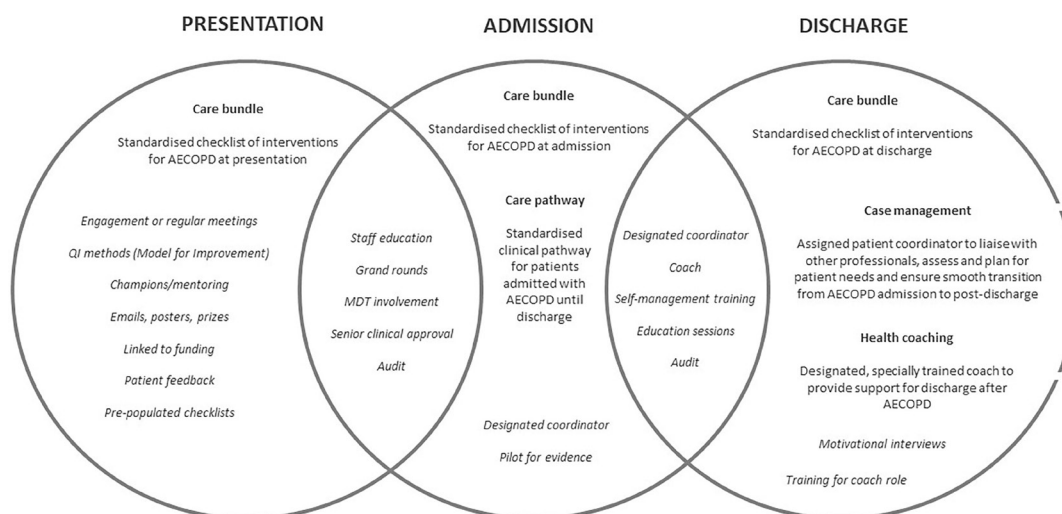


Figure 2 Implementation supports by intervention type. AECOPD, acute exacerbations of chronic obstructive pulmonary disease; MDT, multidisciplinary teams; QI, quality improvement.

recommended to examine this aspect of improvement outcomes.

CONCLUSIONS

The aim of this review was to seek primary evidence from existing literature relating to improvement interventions which seek to achieve better outcomes such as standardisation of care at presentation, admission and/or discharge and reduction in unnecessary admission/readmission rates for patients with AECOPD. This summary provides evidence of a supportive approach for policy-makers, planners and medical practitioners in designing implementation supports for testing new interventions. Though a number of the studies reported no significant change in the primary stated outcome of reduced LOS, readmissions or use of health services, most saw a trend in improved outcomes in their intervention populations including person-centred elements such as patient confidence and understanding of their disease, and staff adherence to bundle interventions. Several studies presented here state that engagement with the front-line staff-users of the intervention, whether bundle or pathway, enhances sustainability of improvements. When designing a new improvement initiative for AECOPD care, consideration of the implementation strategy and methods of support will be necessary. In the Irish context, QI Collaborative methodology will be adapted to work with up to 20 front-line teams across Ireland to use the Model for Improvement and PDSA cycles to design and test bespoke local service improvements that reflect national strategic priorities of standardised, evidence-based AECOPD care.

Author affiliations

- ¹Quality Improvement, Royal College of Physicians of Ireland, Dublin, Ireland
²Research Department, Royal College of Physicians of Ireland, Dublin, Ireland
³Dept. of Respiratory Medicine, Beaumont Hospital, Dublin, Ireland
⁴Healthcare Integration and Improvement, University College Dublin, Dublin, Ireland
⁵Acute Medicine & Respiratory Medicine, St Vincent's University Hospital, Dublin, Ireland
⁶Dept. of Respiratory Medicine, South Tipperary General Hospital, Clonmel, Tipperary, Ireland
⁷Respiratory Physiotherapy, Midland Regional Hospital Portlaoise, Portlaoise, Laois, Ireland
⁸National Clinical Programme Respiratory, Health Service Executive, Dublin, Ireland

Contributors Thank you to all contributors to this paper. RM as lead author, OW, SW and LP as research associates. All reviewers; TM, BC, JB, EK, AC, KB, NM and AL; contributed to the study selection and draft review process. RM, OW, SW, LP and TM read and approved the final manuscript.

Funding The National COPD Collaborative in Ireland is funded by Clinical Strategy and Programmes, Health Service Executive Ireland.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and

responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Rachel MacDonell <http://orcid.org/0000-0003-3467-302X>

REFERENCES

- Global Initiative for Chronic Obstructive Lung Disease. *Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease*, 2020.
- Fromer L. Diagnosing and treating COPD: understanding the challenges and finding solutions. *Int J Gen Med* 2011;4:729–39.
- Soriano JB, Rodríguez-Roisin R. Chronic obstructive pulmonary disease overview: epidemiology, risk factors, and clinical presentation. *Proc Am Thorac Soc* 2011;8:363–7.
- Quaderi SA, Hurst JR. The unmet global burden of COPD. *Glob Health Epidemiol Genom* 2018;3:e4.
- GBD 2015 Chronic Respiratory Disease Collaborators. Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990–2015: a systematic analysis for the global burden of disease study 2015. *Lancet Respir Med* 2017;5:691–706.
- Lozano R, Naghavi M, Foreman K, *et al*. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the global burden of disease study 2010. *Lancet* 2012;380:2095–128.
- Lortet-Tieulent J, Soerjomataram I, López-Campos JL, *et al*. International trends in COPD mortality, 1995–2017. *Eur Respir J* 2019;54. doi:10.1183/13993003.01791-2019. [Epub ahead of print: 19 Dec 2019].
- Guarascio AJ, Ray SM, Finch CK, *et al*. The clinical and economic burden of chronic obstructive pulmonary disease in the USA. *Clinicoecon Outcomes Res* 2013;5:235–45.
- May SM, Li JTC. Burden of chronic obstructive pulmonary disease: healthcare costs and beyond. *Allergy Asthma Proc* 2015;36:4–10.
- Lisspers K, Larsson K, Johansson G, *et al*. Economic burden of COPD in a Swedish cohort: the Arctic study. *Int J Chron Obstruct Pulmon Dis* 2018;13:275–85.
- Donaldson GC, Seemungal TAR, Bhowmik A, *et al*. Relationship between exacerbation frequency and lung function decline in chronic obstructive pulmonary disease. *Thorax* 2002;57:847–52.
- Seemungal TA, Donaldson GC, Paul EA, *et al*. Effect of exacerbation on quality of life in patients with chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1998;157:1418–22.
- Alqahtani JS, Njoku CM, Bereznicki B, *et al*. Risk factors for all-cause Hospital readmission following exacerbation of COPD: a systematic review and meta-analysis. *Eur Respir Rev* 2020;29. doi:10.1183/16000617.0166-2019. [Epub ahead of print: 30 Jun 2020].
- Cushen B, Sulaiman I, Greene G, *et al*. The clinical impact of different adherence behaviors in patients with severe chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2018;197:1630–3.
- Lindenauer PK, Dharmarajan K, Qin L, *et al*. Risk trajectories of readmission and death in the first year after hospitalization for chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2018;197:1009–17.
- Hartl S, Lopez-Campos JL. Readmission in COPD patients: should we consider it a marker of quality of care or a marker of a more severe disease with a worse prognosis? *Eur Respir J* 2016;48:281–2.
- Breunig IM, Shaya FT, Scharf SM. Delivering cost-effective care for COPD in the USA: recent progress and current challenges. *Expert Rev Pharmacoecon Outcomes Res* 2012;12:725–31.
- Hanania NA, Marciniuk DD. A unified front against COPD: clinical practice guidelines from the American College of physicians, the American College of chest physicians, the American thoracic Society, and the European respiratory Society. *Chest* 2011;140:565–6.



- 19 World Health Organisation. Global action plan for the prevention and control of NCDs 2013-2020, 2012. Available: https://www.who.int/nmh/events/ncd_action_plan/en/
- 20 Tricco AC, Lillie E, Zarin W, *et al.* PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467-73.
- 21 Peters MDJ, Godfrey CM, Khalil H, *et al.* Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* 2015;13:141-6.
- 22 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19-32.
- 23 Moher D, Shamseer L, Clarke M, *et al.* Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;4:1.
- 24 MacDonell R, Woods O, Prihodova L. Interventions at presentation and discharge for patients with acute exacerbation of chronic obstructive pulmonary disease to reduce unnecessary admissions and readmissions: a scoping review protocol. *Nurs Open* 2020;7:669-673.
- 25 Horner DL, Bellamy MC. Care bundles in intensive care. *Continuing Education in Anaesthesia Critical Care & Pain* 2012;12:199-202.
- 26 Schrijvers G, van Hoorn A, Huiskes N. The care pathway: concepts and theories: an introduction. *Int J Integr Care* 2012;12:e192.
- 27 Lukersmith S, Millington M, Salvador-Carulla L. What is case management? A scoping and mapping review. *Int J Integr Care* 2016;16:2.
- 28 Wolever RQ, Simmons LA, 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;2:38-57.
- 29 McCarthy C, Brennan JR, Brown L, *et al.* Use of a care bundle in the emergency department for acute exacerbations of chronic obstructive pulmonary disease: a feasibility study. *Int J Chron Obstruct Pulmon Dis* 2013;8:605-11.
- 30 Miller C, Cushley C, Redler K, *et al.* Improving the acute care of COPD patients across Gloucestershire: a quality improvement project. *BMJ Qual Improv Rep* 2015;4. doi:10.1136/bmjquality.u208427.w3338. [Epub ahead of print: 19 Nov 2015].
- 31 Hopkinson NS, Englebretsen C, Cooley N, *et al.* Designing and implementing a COPD discharge care bundle. *Thorax* 2012;67:90-2.
- 32 Laverty AA, Elkin SL, Watt HC, *et al.* Impact of a COPD discharge care bundle on readmissions following admission with acute exacerbation: interrupted time series analysis. *PLoS One* 2015;10:e0116187.
- 33 Zafar MA, Panos RJ, Ko J, *et al.* Reliable adherence to a COPD care bundle mitigates system-level failures and reduces COPD readmissions: a system redesign using improvement science. *BMJ Qual Saf* 2017;26:908-18.
- 34 Epstein D, Barak-Corren Y, Isenberg Y, *et al.* Clinical decision support system: a pragmatic tool to improve acute exacerbation of COPD discharge recommendations. *COPD* 2019;16:18-24.
- 35 Morton K, MacNeill S, Sanderson E, *et al.* Evaluation of 'care bundles' for patients with chronic obstructive pulmonary disease (COPD): a multisite study in the UK. *BMJ Open Respir Res* 2019;6:e000425.
- 36 Pendharkar SR, Ospina MB, Southern DA, *et al.* Effectiveness of a standardized electronic admission order set for acute exacerbation of chronic obstructive pulmonary disease. *BMC Pulm Med* 2018;18:93.
- 37 Ban A, Ismail A, Harun R, *et al.* Impact of clinical pathway on clinical outcomes in the management of COPD exacerbation. *BMC Pulm Med* 2012;12:27.
- 38 Vanhaecht K, Lodewijckx C, Sermeus W, *et al.* Impact of a care pathway for COPD on adherence to guidelines and hospital readmission: a cluster randomized trial. *Int J Chron Obstruct Pulmon Dis* 2016;11:2897-908.
- 39 Ohar JA, Loh CH, Lenoir KM, *et al.* A comprehensive care plan that reduces readmissions after acute exacerbations of COPD. *Respir Med* 2018;141:20-5.
- 40 Santamaria N, Connors A-M, Oosteraas J, *et al.* A prospective cohort study of the effectiveness of clinical pathways for the in-patient management of acute exacerbation of chronic obstructive pulmonary disease (COPD). *Collegian* 2004;11:12-16.
- 41 McManus TE, Marley A-M, Kidney JC. The Mater Hospital multiprofessional care pathway for acute exacerbations of chronic obstructive pulmonary disease. *J Integr Care* 2005;9:32-6.
- 42 Nishimura K, Yasui M, Nishimura T, *et al.* Clinical pathway for acute exacerbations of chronic obstructive pulmonary disease: method development and five years of experience. *Int J Chron Obstruct Pulmon Dis* 2011;6:365-72.
- 43 Garcia-Aymerich J, Hernandez C, Alonso A, *et al.* Effects of an integrated care intervention on risk factors of COPD readmission. *Respir Med* 2007;101:1462-9.
- 44 Abad-Corpa E, Royo-Morales T, Iñiesta-Sánchez J, *et al.* Evaluation of the effectiveness of hospital discharge planning and follow-up in the primary care of patients with chronic obstructive pulmonary disease. *J Clin Nurs* 2013;22:no-80.
- 45 Moullec G, Lavoie KL, Rabhi K, *et al.* Effect of an integrated care programme on re-hospitalization of patients with chronic obstructive pulmonary disease. *Respirology* 2012;17:707-14.
- 46 Lainscak M, Kadivec S, Kosnik M, *et al.* Discharge coordinator intervention prevents hospitalizations in patients with COPD: a randomized controlled trial. *J Am Med Dir Assoc* 2013;14:450.e1-450.e6.
- 47 Gay E, Desai S, McNeil D. A multidisciplinary intervention to improve care for high-risk COPD patients. *Am J Med Qual* 2020;35:231-5.
- 48 Wang Y, Zang X-Y, Bai J, *et al.* Effect of a health belief model-based nursing intervention on Chinese patients with moderate to severe chronic obstructive pulmonary disease: a randomised controlled trial. *J Clin Nurs* 2014;23:1342-53.
- 49 Benzo R, Vickers K, Novotny PJ, *et al.* Health coaching and chronic obstructive pulmonary disease rehospitalization: A randomized study. *Am J Respir Crit Care Med* 2016;194:672-80.
- 50 Bourbeau J, Echevarria C. Models of care across the continuum of exacerbations for patients with chronic obstructive pulmonary disease. *Chron Respir Dis* 2020;17:1479973119895457.
- 51 Lavallée JF, Gray TA, Dumville J, *et al.* The effects of care bundles on patient outcomes: a systematic review and meta-analysis. *Implement Sci* 2017;12:142.
- 52 Geerligts L, Rankin NM, Shepherd HL, *et al.* Hospital-Based interventions: a systematic review of staff-reported barriers and facilitators to implementation processes. *Implement Sci* 2018;13:36.
- 53 Aeyels D, Bruyneel L, Seys D, *et al.* Better Hospital context increases success of care pathway implementation on achieving greater teamwork: a multicenter study on STEMI care. *Int J Qual Health Care* 2019;31:442-8.
- 54 Tortajada S, Giménez-Campos MS, Villar-López J, *et al.* Case management for patients with complex multimorbidity: development and validation of a coordinated intervention between primary and hospital care. *Int J Integr Care* 2017;17:4.
- 55 Hudon C, Chouinard M-C, Lambert M, *et al.* Effectiveness of case management interventions for frequent users of healthcare services: a scoping review. *BMJ Open* 2016;6:e012353.
- 56 van Eeden AE, van de Poll I, van Vulpen G, *et al.* Effectiveness of case management in the prevention of COPD re-admissions: a pilot study. *BMC Res Notes* 2017;10:621.
- 57 Rose L, Istanbulian L, Carriere L, *et al.* Program of Integrated Care for Patients with Chronic Obstructive Pulmonary Disease and Multiple Comorbidities (PICOPD⁺): a randomised controlled trial. *Eur Respir J* 2018;51. doi:10.1183/13993003.01567-2017. [Epub ahead of print: 11 Jan 2018].