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

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ABSTRACT

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 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,2,3 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

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 admissions 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.
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individuals. COPD is currently the third-leading cause of death globally. 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, lung health, and quality of life (QoL) for the patient with heightened risk of readmission noted among patients with certain comorbidities and conditions, such as heart failure, renal failure, depression and alcohol use. Mortality rates of patients at 12 months postdischarge due to hospitalisation for AECOPD are over 20%. Huge variations in care have been noted within and between European countries with low adherence to clinical management recommendations. The need to reduce COPD exacerbations and hospitalisations has been recognised by guideline development bodies, researchers and clinicians, with international consensus guidelines calling for implementation of evidence-based approaches for improved COPD diagnosis and management. WHO ‘25 by 25’ goal aims to reduce global deaths from COPD by 25% by 2025.

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. Scoping reviews are useful to clarify key concepts and identify gaps when examining emerging areas, 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’Malley and Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, has previously been published.

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 below.

Study selection
Relevant articles were screened as previously described. 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 previously; 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

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

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

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Table 2  Review inclusion/exclusion criteria

<table>
<thead>
<tr>
<th>Criteria for inclusion</th>
<th>Criteria for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peers-reviewed, primary evidence, journal articles, published between 1 January 2000 and 20 September 2020, English only.</td>
<td>Studies not meeting the inclusion criteria.</td>
</tr>
<tr>
<td>Concerning adults with COPD.</td>
<td>Studies which primarily refer to aetiology, physiology, environmental factors, medical treatment (including pharmacology).</td>
</tr>
<tr>
<td>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.</td>
<td>Studies which primarily examine predictive modelling, risk assessment, economic burden or cost savings at societal level.</td>
</tr>
<tr>
<td>Included a detailed description and explanation of the intervention or implementation strategy.</td>
<td>Studies which do not present an intervention or implementation strategy.</td>
</tr>
<tr>
<td>Intervention(s) applied in an acute healthcare setting, for example, hospital or acute healthcare team.</td>
<td>Studies using secondary data.</td>
</tr>
<tr>
<td>Aimed to improve outcomes in admission rates, admission avoidance, length of stay, readmission rates or time to care.</td>
<td></td>
</tr>
</tbody>
</table>

COPD, chronic obstructive pulmonary disease.
Table 3  Study characteristics by intervention type

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>First author</th>
<th>Year</th>
<th>Location</th>
<th>Study type</th>
<th>Aim</th>
<th>Setting</th>
<th>Participants</th>
<th>Sample size</th>
<th>COPD disease stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care bundle</td>
<td>Laverty32</td>
<td>2011</td>
<td>UK</td>
<td>Quality Improvement report</td>
<td>To develop and pilot the implementation of a COPD discharge care bundle</td>
<td>Respiratory ward in a city hospital (England)</td>
<td>Patients admitted with AECOPD</td>
<td>94 patients</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Miller30</td>
<td>2013</td>
<td>Ireland</td>
<td>Feasibility study</td>
<td>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</td>
<td>Emergency department (ED) in a university teaching hospital</td>
<td>Patients presenting to ED with AECOPD (50 pre, 51 post)</td>
<td>101 patients</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Zafar33</td>
<td>2015</td>
<td>UK</td>
<td>Interrupted time series analysis</td>
<td>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</td>
<td>Nine NHS acute hospitals across three trusts (England)</td>
<td>AECOPD admissions aged ≤45 years</td>
<td>9 hospitals</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Pendharker36</td>
<td>2015</td>
<td>UK</td>
<td>Quality Improvement project</td>
<td>To improve compliance with the British Thoracic Society guidelines and Commissioning for Quality and Innovation scheme for patients admitted with AECOPD</td>
<td>Unscheduled care setting in one hospital</td>
<td>Front-line medical teams in unscheduled care of COPD patients plus nursing support</td>
<td>Described as small</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Morton35</td>
<td>2017</td>
<td>USA</td>
<td>Quasi-experimental study and ‘model for improvement’</td>
<td>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</td>
<td>800-bed, academic (hospital) health centre (regional referral hospital; USA)</td>
<td>AECOPD (documented, clinical diagnosis)</td>
<td>207 admissions</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Epstein34</td>
<td>2018</td>
<td>Canada</td>
<td>Analysis of administrative health data for a quality improvement project</td>
<td>To determine whether the implementation of an evidence-based computerised admission order set would improve the quality of inpatient AECOPD care</td>
<td>Large, tertiary care teaching hospital</td>
<td>Patients with AECOPD with a LOS less than 90 days</td>
<td>1413 patients</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Santamaria40</td>
<td>2019</td>
<td>UK</td>
<td>Mixed-methods, controlled before- and-after study with nested case studies</td>
<td>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</td>
<td>19 acute hospitals in England and Wales</td>
<td>All COPD admissions</td>
<td>4657 admissions</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>McManus41</td>
<td>2019</td>
<td>Israel</td>
<td>Pragmatic study (pre- and post-intervention study)</td>
<td>To evaluate the effect of this tool on rates of adherence to published guidelines</td>
<td>A 1000-bed academic hospital serving over 2 million residents in northern Israel</td>
<td>Patients with AECOPD</td>
<td>367 patients received the intervention</td>
<td>Not described</td>
</tr>
<tr>
<td>Intervention type</td>
<td>First author</td>
<td>Year</td>
<td>Location</td>
<td>Study type</td>
<td>Aim</td>
<td>Setting</td>
<td>Participants</td>
<td>Sample size</td>
<td>COPD disease stage</td>
</tr>
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</tr>
<tr>
<td>Care pathway</td>
<td>Nishimura</td>
<td>2004</td>
<td>Australia</td>
<td>Prospective cohort study (group design)</td>
<td>To compare the clinical and functional outcomes of patients with an AECOPD treated with standard care to those treated with a clinical pathway</td>
<td>A large regional referral centre</td>
<td>Patients who were hospitalised and who were treated according to the clinical pathway for AECOPD</td>
<td>178 patients (88 intervention, 90 standard care)</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Ban</td>
<td>2005</td>
<td>Northern Ireland</td>
<td>Prospective study</td>
<td>To ensure delivery of evidence-based practice, optimised care, reduced LOS and reduced mortality through implementation of a care pathway</td>
<td>An inner-city area district general hospital recognised for its social deprivation</td>
<td>Patients with AECOPD</td>
<td>85 patients</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Vanhaecht</td>
<td>2011</td>
<td>Japan</td>
<td>Prospective observation (5 years)</td>
<td>To evaluate the outcomes of patients hospitalised with AECOPD in Japan, treated with a clinical pathway following published guidelines</td>
<td>An urban general hospital</td>
<td>Patients who were hospitalised and treated according to the clinical pathway for AECOPD</td>
<td>276 hospitalisations of 165 patients</td>
<td>Stage I, II, III and IV COPD</td>
</tr>
<tr>
<td></td>
<td>Ohar</td>
<td>2012</td>
<td>Malaysia</td>
<td>Non-randomised prospective study with historical controls</td>
<td>To evaluate the effectiveness of implementation of a care pathway for AECOPD</td>
<td>An urban university medical centre</td>
<td>Patients admitted with AECOPD</td>
<td>193 patients (95 intervention, 98 historical control)</td>
<td>Stage II, III and IV COPD</td>
</tr>
<tr>
<td></td>
<td>Garcia-Aymerich</td>
<td>2016</td>
<td>Belgium, Italy, Portugal</td>
<td>International cluster randomised controlled trial</td>
<td>To evaluate whether implementation of a care pathway for COPD improves the 6-months readmission rate</td>
<td>Twenty-two hospitals</td>
<td>Patients admitted with AECOPD</td>
<td>342 patients (174 intervention, 168 control)</td>
<td>GOLD I - IV (mild - very severe)</td>
</tr>
<tr>
<td></td>
<td>Abad-Corpa</td>
<td>2018</td>
<td>USA</td>
<td>Retrospective, electronic health record based, observational cohort study</td>
<td>To evaluate the efficacy of an AECOPD Care plan programme</td>
<td>Medicare single site hospital</td>
<td>Patients admitted with AECOPD</td>
<td>1274 index admissions</td>
<td>Not described</td>
</tr>
</tbody>
</table>

Table 3 Continued
<table>
<thead>
<tr>
<th>Intervention type</th>
<th>First author</th>
<th>Year</th>
<th>Location</th>
<th>Study type</th>
<th>Aim</th>
<th>Setting</th>
<th>Participants</th>
<th>Sample size</th>
<th>COPD disease stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinated Lainscak case management</td>
<td>Moulec</td>
<td>2007</td>
<td>Spain</td>
<td>Randomised controlled trial</td>
<td>To assess the effectiveness of an integrated care intervention at discharge</td>
<td>One urban tertiary hospital</td>
<td>Patients recently discharged after AECOPD</td>
<td>113</td>
<td>Mostly severe COPD</td>
</tr>
<tr>
<td></td>
<td>Lainscak</td>
<td>2012</td>
<td>Spain</td>
<td>Quasi-experimental design</td>
<td>To evaluate the effectiveness of protocol intervention for hospital discharge and follow-up in the primary care of patients with COPD</td>
<td>Two university tertiary-level public hospitals and their related local primary healthcare centres</td>
<td>Patients admitted into hospital with a main diagnosis of COPD</td>
<td>143</td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td>Gay</td>
<td>2012</td>
<td>Canada</td>
<td>Retrospective, longitudinal cohort study</td>
<td>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*</td>
<td>One urban and one suburban hospital</td>
<td>Patients with a primary diagnosis of COPD and a history of hospitalisations of at least 48 hours duration, due to exacerbations of COPD</td>
<td>189</td>
<td>Mostly moderate to severe COPD</td>
</tr>
<tr>
<td></td>
<td>Wang</td>
<td>2013</td>
<td>Slovenia</td>
<td>Randomised controlled trial</td>
<td>To test whether coordination of discharge from hospital and postdischarge care reduces hospitalisations in patients with COPD</td>
<td>Specialised pulmonary hospital</td>
<td>Admitted with AECOPD, with reduced pulmonary function</td>
<td>253</td>
<td>Mostly severe COPD</td>
</tr>
<tr>
<td></td>
<td>Benzo</td>
<td>2019</td>
<td>Pilot study (quality project)</td>
<td>Pilot study (quality project)</td>
<td>To improve the quality of care for patients with COPD and reduce readmissions</td>
<td>Large urban teaching hospital</td>
<td>Patients admitted with AECOPD</td>
<td>157</td>
<td>Not described</td>
</tr>
<tr>
<td>Health coaching</td>
<td>Horner</td>
<td>2014</td>
<td>China</td>
<td>Randomised controlled trial</td>
<td>To test the effect of a Health Belief Model-based nursing intervention on healthcare outcomes in Chinese patients with moderate to severe COPD</td>
<td>Respiratory ward in a university general hospital</td>
<td>Patients with moderate to severe COPD admitted to the respiratory ward</td>
<td>92</td>
<td>Moderate to severe COPD</td>
</tr>
<tr>
<td></td>
<td>Schrijvers</td>
<td>2016</td>
<td>USA</td>
<td>Randomised controlled trial</td>
<td>To determine the effect of comprehensive health coaching on the rate of COPD readmissions</td>
<td>Two hospitals</td>
<td>Patients admitted with AECOPD</td>
<td>215</td>
<td>Not described</td>
</tr>
</tbody>
</table>

AECOPD, acute exacerbations of chronic obstructive pulmonary disease; LOS, length of stay; NHS, National Health Service.
supposes the coordination, integration and management of a patient’s health and social care needs (27) 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 condition (28). 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) (32) (33) (34) one implemented both an admission and discharge bundle (35) 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 bundle (29) 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) (38) (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) (39) (40) (41) 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 steps or coordinated clinical audit, workshops, teaching sessions and meetings with pathway facilitators. (38) LOS was frequently measured and results varied from no change (38) to a non-significant 0.89-day improvement (40) to significant reductions of 2 days (37) 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) Vanhaeckt 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

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>Care bundle (eight articles)</th>
<th>Care pathway (six articles)</th>
<th>Coordinated case management (five articles)</th>
<th>Health coaching (two articles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage of AECOPD Care Pathway Impacted</td>
<td>Presentation 29–30 36</td>
<td>Admission through to discharge 37–42</td>
<td>Admission through to discharge 46</td>
<td>Admission through to discharge 48</td>
</tr>
<tr>
<td></td>
<td>Admissions 30–35</td>
<td>Discharge 31–34</td>
<td>Discharge planning 43–45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presentation through to discharge 36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention elements</td>
<td>Multidisciplinary team design 29–33 35 39–42</td>
<td>Multidisciplinary team design 37–40–42 44</td>
<td>Inpatient specialist visits 46–47</td>
<td>Inpatient specialist visits 48 49</td>
</tr>
<tr>
<td></td>
<td>Assessment or investigation 29 30 35 36</td>
<td>Assessment/investigation at presentation 37 39–41</td>
<td>Patient education 43–46</td>
<td>Patient education 48 49</td>
</tr>
<tr>
<td></td>
<td>Initial or ongoing treatment 29 30</td>
<td>Admission through to discharge 37–42</td>
<td>Self-management strategies 43</td>
<td>Written information 48 49</td>
</tr>
<tr>
<td></td>
<td>Medication 29 34–36</td>
<td>Discharge planning 37–40–42</td>
<td>Postdischarge home visit 43 44 46</td>
<td>Personal health goals 49</td>
</tr>
<tr>
<td></td>
<td>Respiratory specialist consultation 29 31–35 36</td>
<td>Initial or ongoing treatment/medication prompts 37 38 40–42</td>
<td>Liaison with other specialists 43–47</td>
<td>Self-management strategies (incl. exercise) 48 49</td>
</tr>
<tr>
<td></td>
<td>Patient education 31–33 35 36</td>
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<td>Postdischarge home visit 49</td>
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<td>Key disciplines involved in implementation</td>
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<td>Medicine 30 31 33 34 36</td>
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<td>Pharmacy 37 38 40–42</td>
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Continued
### Table 4 Continued

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<tr>
<th>Intervention type</th>
<th>Methodology and supports for implementation</th>
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<td>Email reminders</td>
<td>Emergency department presentations</td>
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<td>Inbuilt electronic system</td>
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Some articles contain multiple PICO criteria in each category.

AECOPD, acute exacerbations of chronic obstructive pulmonary disease; PICO, population, intervention(s), context and outcomes.
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 admission46 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 analysis43 44 46 and self-management strategy discussion.43 45 Key features of the postdischarge support included ongoing liaison with other specialists from acute,45 primary and community care,43–46 follow-up telephone support44–47 and dedicated telephone support for families or primary care providers.43–46

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-Áymerich 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.45 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-based29 30 33 or electronic format33 36 bundles were promoted to enhance standardisation of care, boost adherence to guidelines and allow opportunities to identify and rectify missed elements...
of care. QI methodology, such as stakeholder engagement and iterative service redesign and testing, was used effectively to increase adherence to bundle interventions through engagement with frontline clinicians, raising awareness and understanding of the use of care bundles. Increased compliance with bundle elements was associated with reduced LOS and reduced hospital readmissions.

Morton et al paper noted that although clinical outcomes were not significantly improved, staff perceptions of care bundles were largely positive. Bundles were described as useful for standardisation of care, providing clarity around the patient pathway, facilitating effective interdisciplinary communication and identifying post-discharge support needs. 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.

Epstein et al propose several key features of their tool that others might model for success including user-friendly design with pre-population according to evidence-based guidelines, seamless integration into existing electronic resources and provision of clinical decision support to help clinicians under pressure. 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.

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. Involvement of those responsible for enacting the change was found to support implementation with stakeholder meeting engagements, end-user feedback and mixed communication methods all contributing to improved implementation. Additional supports such as electronic prompts and prefilled templates were found to be helpful, as was nominating champions or offering rewards for bundle compliance. 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. 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 post-discharge telephone follow-up. Four pathways included in-hospital patient education elements, with three conducting introductory training sessions for staff. Four pathways were overseen by a dedicated coordinator, with the other two relying on MDT clinicians to implement the pathway.

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. Audit was also used by McManus et al. The designated coordinator role aided pathway compliance however, difficulties arose if an AECOPD admission was not identified, and therefore, did not receive standardised care.

Two papers noted attributed enhanced teamwork practices and reduced patient anxiety to implementation of the care pathway. Elsewhere, hospital culture and context has been linked to the likelihood of implementation success, improvement in care pathway processes and improved teamwork or team climate. 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. Interventions comprised individualised education sessions, self-management strategies and personalised case management including liaison with other services, such as social or palliative care and patient follow-up for between 6 and 12 months after discharge. Importantly, a focus on patient education and promotion of self-management strategies appeared to increase patient understanding of their disease, improve QoL and positively impact overall mortality.

Studies presented elsewhere agree; coordinated case management can provide well-defined, integrated/shared-care arrangements between levels of care that are sustainable, person-centred and have the potential to reduce LOS, readmission rates, mortality and healthcare costs. Like the care pathways, case management interventions were found to be context-dependent, requiring a tailored approach in any setting and should take account of individual patient needs. 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 intensive due to the
requirement for a dedicated, trained staff member to implement the intervention. Benefits include versatility in design as it is delivered onsite during admission and thereafter, by telephone. However, patients’ feelings of attention and support from the health coach may influence outcomes. 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. Supervision of coaching sessions and use of a checklist to evaluate session content may provide support and feedback to the health coach.

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 shown to standardise care and improve care outcomes for patients with AECOPD and other chronic conditions or clinical situations. Similarly, interventions overseen by a dedicated coordinator role, whether as case manager or health coach, have had positive impact on care standardisation, LOS, readmission rate, and QoL. 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 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. Others noted potential for cost savings through reduced LOS or readmissions. 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 policymakers, 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.

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REFERENCES


pathway for COPD on adherence to guidelines and hospital
2012;12:27.

Med


management prevents hospitalizations in patients with COPD: a
randomized controlled trial. J Am Med Dir Assoc 2013;14:450–
e1–450.e6.

Gay E, Desai S, McNiel D. A multidisciplinary intervention to improve

nursing intervention on Chinese patients with moderate to severe
chronic obstructive pulmonary disease: a randomised controlled

Beim B, Vickers A, Health coaching and chronic obstructive pulmonary

Bourbeau J, Echevarria C. Models of care across the continuum of
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Geertigs L, Rankin NM, Shepherd HL, et al. Hospital-Based
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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
Greater teamwork: a multicenter study on STEMI care. Int J
Health Care 2010;26:908–18.

Zafar MA, Cushey C, Pedler K, et al. Reliable adherence to a COPD
care bundle mitigates system-level failures and reduces COPD
readmissions: a system redesign using improvement science. BMJ

bundles’ for patients with chronic obstructive pulmonary disease
(COPD): a multisite study in the UK. BMJ Open Respir Res 2019;
5:e000425.

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.

clinical outcomes in the management of COPD exacerbation. BMC

pathway for COPD on adherence to guidelines and hospital
readmission: a cluster randomized trial. Int J Chron Obstruct Pulm

Open access

Multiple Comorbidities (PIC COPD+): a randomised controlled trial.

McManus TE, Marley A-M, Kidney JC. The mater Hospital
multiprofessional care pathway for acute exacerbations of chronic


MacDonell R, Woods O, Prithodova L. Interventions at presentation
and discharge for patients with COPD: a systematic review and

management prevents hospitalizations in patients with COPD: a
randomized controlled trial. J Am Med Dir Assoc 2013;14:450–
e1–450.e6.

Gay E, Desai S, McNiel D. A multidisciplinary intervention to improve

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Health Care 2010;26:908–18.

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Greater teamwork: a multicenter study on STEMI care. Int J
Health Care 2010;26:908–18.