

Development of an Electronic Interdisciplinary Chronic Obstructive Pulmonary Disease (COPD) Proforma (E-ICP) to Improve Interdisciplinary Guideline Adherence in the Emergency Department: Modified Delphi Study

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Introduction: Chronic obstructive pulmonary disease guideline non-adherence is associated with a reduction in health-related quality of life in patients (HRQoL). Improving guideline adherence has the potential to mitigate fragmented care thereby sustaining pulmonary function, preventing acute exacerbations, reducing economic health burdens, and enhancing HRQoL. The development of an electronic proforma stemming from expert consensus, including digital guideline resources and direct interdisciplinary referrals is hypothesised to improve guideline adherence and patient outcomes for emergency department (ED) patients with COPD.

Aim: The aim of this study was to develop consensus among ED and respiratory staff for the correct composition of a COPD electronic proforma that aids in guideline adherence and management in the ED.

Methods: This study adopted a mixed-method design to develop the most important indicators of care in the ED. The study involved three phases: (1) a systematic literature review and qualitative interdisciplinary staff interviews to assess barriers and solutions for guideline adherence and qualitative interdisciplinary staff interviews, (2) a modified Delphi panel to select interventions for the proforma, and (3) a consensus process through three rounds of scoring through a quantitative survey (ED and Respiratory consensus) and qualitative thematic analysis on each indicator.

Results: The electronic proforma achieved acceptable and good internal consistency through all iterations from national emergency department and respiratory department interdisciplinary experts. Cronbach's alpha score for internal consistency (α) in iteration 1 emergency department cohort (EDC) ($\alpha = 0.80$ [CI = 0.89%]), respiratory department cohort (RDC) ($\alpha = 0.95$ [CI = 0.98%]). Iteration 2 reported EDC ($\alpha = 0.85$ [CI = 0.97%]) and RDC ($\alpha = 0.86$ [CI = 0.97%]). Iteration 3 revealed EDC ($\alpha = 0.73$ [CI = 0.91%]) and RDC ($\alpha = 0.86$ [CI = 0.95%]), respectively.

Conclusion: Electronic proformas have the potential to facilitate direct referrals from the ED leading to reduced hospital admissions, reduced length of hospital stays, holistic care, improved health care and quality of life and improved interdisciplinary guideline adherence.

Keywords: COPD, electronic proforma, modified Delphi study, interdisciplinary, guideline adherence, COPD-X plan

Introduction

Chronic obstructive pulmonary disease exacerbations are the leading cause of unplanned hospital admissions worldwide.¹ COPD is the second leading cause of avoidable Australian hospital admissions.² Preventing COPD readmissions

following an exacerbation has been identified as an international priority to sustain pulmonary function, reduce economic health burdens and improve health-related quality of life with COPD patients.¹ The World Health Organization has predicted COPD to become the third leading cause of death by 2030 considering its recent increase in prevalence and morbidity.^{2,3} Australasian research reports that 5% of all emergency department (ED) presentations include shortness of breath and 14% of these presentations were diagnosed with COPD.⁴ An exploratory systematic review and interdisciplinary qualitative reviews revealed contributing factors towards guideline non-adherence to be decreased awareness, lack of familiarity, lack of knowledge of referral process, role confusion, lack of interdisciplinary communication and a lack of cues/guidelines in the working environment.^{5,6} Economic data from an Australian review of three major tertiary hospitals revealed a total annual health service cost of 20 million AUD for ED presentations across three major health service districts.⁷ That study reported that 41.1% of ED presentations assessed as Australian Triage Scale category 3 (urgent) or 4 (semi-urgent) were discharged home on the same day.⁷ A lack of integrated care and discharge planning from the ED is associated with COPD readmissions and exacerbations resulting in breathlessness, reduced activity levels, malnutrition, social isolation, a loss of independence, and depression which all lead to a reduced health-related quality of life (HRQoL).^{8–13}

The main research aim is to develop a proforma for implementation in the ED to improve guideline adherence and the secondary aim and potential benefit is holistic primary-care referrals, and reduced hospital admissions to ED. An electronic proforma has the potential to serve as a pragmatic implementation research initiative specifically focussed on the needs of ED interdisciplinary staff.^{14,15} Challenges in the acute clinical setting include a lack of a single integrated platform, supporting infrastructure, interdisciplinary staff capacity, lack of clinician training and support for under-confident clinicians to use digital devices, and a lack of critical information at point of care.^{13,16,17} An electronic proforma acquires the desired capabilities if integrated with an existing electronic medical record to reduce interdisciplinary staff cognitive burden, and in the provision of consistent information through guidelines, consistent patient resources and information, integration of clinical data and decision making at point of care, one-step referrals within outpatient clinics and primary care, as well as consistent staff training.^{18–20} Developing relevant ED-focussed quality indicators have been noted as important in improving care outcomes.^{7,13,21} Appropriate delegation and handover of chronic care referrals potentially can reduce ED COPD readmissions and improve HRQoL for these patients.^{7,15} This study aimed to develop a proforma for ED departments to improve guideline adherence amongst ED interdisciplinary clinicians. The imperative perspective here is from ED interdisciplinary staff verified and validated by respiratory interdisciplinary staff.

Methods

A modified Delphi approach has been recognised as a valid and pivotal approach to understanding departmental-based needs, with this research involving respiratory and ED interdisciplinary clinicians.^{22–24} This process has aided in achieving the aim of gaining consensus on the indicators and feasibility of electronic COPD guideline recommendations embedded in intranet systems specifically in the ED. Ethics was approved at the University of Southern Queensland (H21REA007). All participants were provided with a research participation information sheet and consent obtained prior to each iteration completion.

This modified Delphi approach used a mixed-method design utilising quantitative survey questions and qualitative thematic analysis to develop a COPD proforma with specific clinical-driven content for ED. Most important indicators of care in the ED were selected (a set of evidence-based interventions applied to improve clinical outcomes) involving three phases: (1) a systematic literature review to assess barriers and solutions for guideline adherence,²⁵ (2) a modified Delphi panel to select interventions for the bundle, and (3) consensus process through three rounds of scoring quantitative survey and qualitative thematic analysis on each indicator (see Figure 1). An E-Delphi technique appeared to be the most suitable method to gain consensus among emergency department and respiratory department interdisciplinary experts to develop and determine content validity and realistic implementation probability of the E-ICP considering the primary aim was to increase guideline adherence utilising E-ICP.²³ The protocol for methods and stages of each iteration of this study is published elsewhere.²⁶ A national panel of experts was created by utilising systematic review authorship. Participants were recognised from systematic review authorship and had an established academic profile in COPD research practice

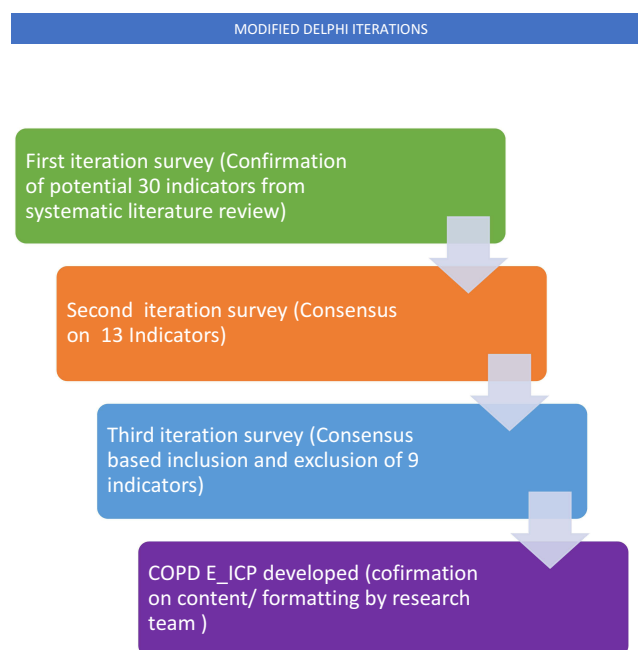


Figure 1 Graphical representation of modified Delphi iterations and processes from systematic review phase for identification of indicators to final development of E-ICP.

and/or were recognised by expert clinicians through peer referral as a COPD clinician expert or ED speciality interdisciplinary staff. A modified Delphi method or E-Delphi method where all iterations are administered online was conducted with quasi anonymity. The respondents did not know each other, however the research team was not blinded of participant responses. Anonymity assisted participants and stakeholders from different disciplines, organisations, and career stages to provide input without domination between ED and respiratory experts to develop E-ICP for ED. In round one, a panel of experts were asked to rate the importance of care indicators and provide additional suggestions for revisions or new items. Consensus was considered reached if at least 70% of the panel strongly agreed that an item should be included or excluded from the proforma. Where agreement was not reached or there were suggestions for altered or new items, these were taken to round two together with an aggregated summary of round one responses. Following the second round, a ranking of indicators was developed, and the final template distributed to panel members for approval. The E-Delphi process facilitates easier accessibility of experts, timely and confidential panel responses, and ease in dissemination of information from previous rounds.

The exploratory phase of the research included a systematic literature review to identify barriers and indicators to develop the first iteration of the Delphi questionnaire. A comprehensive three-tier search strategy was utilised to search nine databases (COCHRANE, EBSCO HOST, MEDLINE, SCIENCE DIRECT, JBI, SCOPUS, WEB OF SCIENCE, WILEY and DARE) in May 2020.⁶ This protocol was also published elsewhere.⁶ We included all articles that reported on international guideline adherence (GOLD) and national guideline adherence (COPD-X plan) within the last decade. The literature proposed 30 indicators as potential barriers and probable solutions to COPD guideline concordance. These indicators were included in the survey questionnaire to understand the level of agreement between interdisciplinary clinicians (see Table 1).

Results

Iteration 1

Qualitative thematic analysis of iteration 1 confirmed the barriers and inscribed potential solutions to improve the proforma content (see Table 1). Theoretical domains framework (TDF) domains are bracketed throughout the Results section for clarity along with Table 1. Interdisciplinary staff expressed a preferred method of learning that must be discussed with staff and embedded to their educational resources through ED orientation packages, posters, electronic

Table 1 Qualitative Thematic Analysis of Expert Quotes to TDF Domains and BCW

TDF Domain and Barriers	COM-B	Recommended Intervention (BCW)	Expert's Quotes Recommendations
Knowledge Lack of educational resources and in services for ED staff Lack of evidence-based pathway specific for ED Lack of easy access of resources Lack of understanding how ED clinicians prefer to learn Lack of appropriate assessments due to lack of awareness	Capability (Physical and psychological)	Training Modelling Enablement	R.A.3 Physio: "multidisciplinary education sessions for ED team regarding current guidelines". E.A.3 Physio: - "Poster, prompts and emails at point of care" R.D.2 Doctor: - "Engagement with ED staff about their preferred methods of learning and adherence to clinical guidelines" E.N.3 Nurse: - "education to all of team and easy access to this education" E.A.1 Physio: - "In-service presentations about guidelines." E.N.7 Nurse: - "Education and training" E.A.2 Pharmacist: - "Assessing inhaler technique and ensuring the patient is using their device correctly is always overlooked. Elderly patients often have issues with using certain inhalers because they have not got the strength or dexterity they once had. If the patient can use their prescribed inhaler correctly this will result in better health outcomes for each patient"
Environmental resources Lack of clear ED section and instructions Lack of staff time for health training services Lack of internet dissemination Lack of leadership for change Lack of resources with electronic platforms and electronic pathways Lack of easier communication platforms between inter-disciplines	Opportunity (Social, Physical)	Environmental restructuring Persuasion Incentivisation	E.N.1 Nurse: - Easy to use format and nurse-initiated referral system E.D.1 Doctor: - Clearer ED section with clear recommendations R.D.1 Doctor: - "client barriers/motivation" R.D.1 Doctor: - "competing demands re staff time/health services, training" R.D.2 Doctor: - "understand time and capacity issues for ED staff, and also how they manage multimorbidity" R.D.3 Doctor: - "Lack of linking information between primary-care and hospital systems and community services through Internet dissemination" E.A.1 Physio: - "Change champions who can be resources in ED for these guidelines, Consultants, Registrars, Nursing staff and Allied Health Staff. - Availability of Respiratory consultant Nurse for patients in ED who can facilitate adherence to COPD guidelines, organise COPD action plan etc" E.N.5 Nurse: - "Frequent in-services for all Allied Health and multidisciplinary staff" E.N.5 Nurse: - Make COPD-X a part of mandatory training for Nursing clinicians Involve education on referrals and COPD-X in Orientation packages for staff as a specialized package ED nursing Pathways for new staffs Involve patient and clinicians during routine audits on guideline usage" E.N.5 Nurse: - Secondment to Respiratory Wards for ED clinicians for up-skilling and to promote awareness/education on the importance of holistic approach to COPD-X Guidelines and referrals through clinical practice Easy access to guidelines on all individual clinicians' desktops" E.N.6 Nurse: - "Emergency staff getting more awareness about COPD and develop a COPD pathway, link the pathway to the patient file when the patient presents to triage" R.N.1 Nurse: - "Education regarding the use of resources initially is essential. This should be provided as education out of the clinical time to allow for total comprehension. It should involve all health professionals involved inclusive of medical, nursing, respiratory specialist (medical and nursing), pharmacist, GP, physiotherapists etc. Education should also be provided to family members and care givers" R.N.1 Nurse: - "The electronic pathways and the ability to access them should be fully comprehended prior to introducing them in the clinical setting. It is very disjointed to teach clinicians on the job in a time-pressured environment" R.A.2 Physio: - "Education to staff in ED regarding the role of Physiotherapy namely airway clearance, exercise and education in the COPD population as per the current COPD-X guidelines may assist in gaining Physiotherapy referrals to see this population in ED and ensure adherence to guidelines" E.N.2 Nurse: improved linkage between specialist respiratory nurses and ED nurses

(Continued)

Table 1 (Continued).

TDF Domain and Barriers	COM-B	Recommended Intervention (BCW)	Expert's Quotes Recommendations
Social professional role identity Lack of communication between different departments Lack of respiratory interdisciplinary staff access in ED Lack of access to respiratory clinical staff for advice or update Lack of cross-fertilisation of knowledge between departments (ED and Resp)	Motivation (Reflective, Automatic)	Enablement Training Coercion	R.D.4 Doctor: - "endorsement from physicians and nurses and other ED professionals that the guidelines do not undermine professional discretion and do not waste professionals' time are a key antecedent to buy in ED staff" E.N.4 Nurse: - "Evidence based treatment pathways COPD management and prevention education to staff Patient-specific management plan developed by respiratory team would benefit individual patients on their presentation to ED" E.A.1 Physio: - "Support from Respiratory physicians and Respiratory medicine Department to implement this model of care if they want to reduce admissions from this patient cohort into their inpatient wards" E.N.6: Nurse: - "All COPD patients discharged from ED should be reviewed by the resp CN for further management" R.A.2 Physio: - "Unable to comment on staff adherence to COPD guidelines in ED and what might improve this as currently Physiotherapy does not receive referrals to see COPD patients in ED or Medical and Planning Short Stay Unit" R.A.3 Physio: - "easy access to respiratory clinical nursing staff in ED" R.D.2 Doctor: - "Understand how ED clinicians undertake their clinical reasoning and management processes, and how digital tools may help (or interfere) - do clinicians prefer their own experience and reasoning and gestalt, rather than prescriptive guidelines/proformas"

Abbreviations: TDF, Theoretical domains framework; COM-B, Capability, opportunity, motivation, behaviour; BCW, Behaviour change wheel; ED, Emergency department; COPD-X, Chronic obstructive pulmonary disease X plan; CN, Clinical nurse.

prompts, in-service education, electronic self-learning modules, as well as easy access to resources at point of care digital platforms (*knowledge*). A respiratory team cross-fertilisation of knowledge and collaboration plan with ED clinicians to initiate patient-specific management plans, evidence-based treatment pathways and electronically linking the plan to the patient file when the patient presents to triage were some suggested resolutions (*knowledge, environmental context and resources, social/professional role identity*). Patient or care-giver education on inhaler technique is indispensable for COPD patients discharged from the ED especially if age, strength, or dexterity is affected (*knowledge*). Lack of linking patient baseline pulmonary function information from primary care, lack of intranet dissemination of guidelines with specific sections for ED care have a substantial role in low guideline adherence (*environmental context and resources*). Lack of professional role clarity, interdepartmental communication and access to respiratory clinical nurses or specialists in ED subsequently causes patient discharges with inadequate community support or unwanted hospital admission for multidisciplinary care (*social/professional role identity, environmental context, and resources*).

Consensus above 80% existed on barriers such as lack of point of care resources (87.2%), lack of time (85.2%), lack of clarity on referral points (ED or inpatient units or GP) (84.2%) and lack of functional care pathways (81.4%) (see Table 2). Each of these considerably contributed to guideline non-concordance. High consensus also existed on prospective solutions where the electronic proforma can provide transfer of knowledge through discharge templates and other COPD educational resources (80%), time-efficient processes of care (87.2%), assisting with evaluation audits and future research to target areas of improvement (87.2%), consistent pharmacological management (85.8%), automatic electronic linkage between hospital and community COPD services will reduce ED utilisation time (88.6%). Simple preformatted order sets (proforma) integrated into the electronic health record platforms (85.2%) were identified to enhance guideline adherence in the ED acting as an educational aid to clinicians (82.8%), interdisciplinary staff and patients. Respiratory clinical nurses consulting with patients in ED to provide referrals and supportive community management highlight key outcomes in reducing length of stay, readmissions, and remissions to inpatient departments (82.8%).

Prominent barriers that aggregated 70–80% expert consensus are lack of smoking cessation support (77.2%) in ED, role clarification between interdepartmental practitioners (74.2%), clarity on how to access relevant multidisciplinary

Table 2 Iteration 1 Results

Barriers/ Enablers to Improve Guideline Adherence	Arithmetic Mean	Standard Deviation	Percentage of Agreement	ED POA	Resp POA
1. Current practice of referral and interdisciplinary service integration follows COPD guideline recommendations in ED	2.9	0.85	58%	55%	58%
2. Lack of knowledge of oxygen administration and delivery devices affects COPD patient management in ED	3.21	1.03	64%	64%	64%
3. Lack of updated COPD guidelines resources within point of care about publishing years affects adherence (2003 to 2017)	3.32	0.67	66%	72%	60%
4. Lack of awareness of guideline existence and skills with COPD management has affected interdisciplinary clinical practice in ED	3.53	1.02	71%	68%	73%
5. Lacking skills to teach device-specific inhaler technique is a barrier amongst interdisciplinary staff	3.84	1.07	77%	72%	82%
6. Lack of time to implement clinical guideline recommendations impacts negatively on their uptake in ED	4.11	0.74	82%	86%	78%
7. Lack of clinical experience or skills impacts negatively on COPD guidelines uptake in ED	3.43	0.77	69%	72%	64%
8. Misalignment of prescribing with COPD recommendations exists between respiratory physicians and general physicians	3.32	0.75	66%	72%	60%
9. Lack of clarity exists amongst interdisciplinary staff whether the clinical recommendations should be performed in ED or inpatient units (e.g. Pulmonary rehabilitation referral, COPD action plan, Home COPD device regimen, Inhaler technique education, vaccination, anxiety, depression screening, Smoking cessation)	4.05	0.85	81%	84%	78%
10. Encourage physical activity and introduce the most appropriate airway clearance technique for patients who have difficulty clearing sputum in ED prior to discharge	3.47	1.07	70%	68%	71%
11. Smoking cessation support should be provided in ED in order to prevent related respiratory unit admission prior to discharge	3.95	0.91	79%	74%	76%
12. Lack of clarity of who or how to access relevant multidisciplinary services affects utilisation of appropriate referral services in ED	3.84	0.76	77%	84%	69%
13. Lack of role clarification between ED, respiratory and general practitioners is a barrier with COPD management to your knowledge	3.47	0.84	69%	70%	69%
14. Lack of functional pathways in the clinical setting to access relevant multidisciplinary services affects uptake of COPD guidelines (e.g. digital referrals, respiratory nurse consultants review in ED, respiratory outpatients referral from ED)	3.95	0.91	79%	82%	76%
15. Psychological status of patient needs to be routinely assessed in ED for anxiety, or depression signs to prevent readmissions related to acopia prior to discharge	3.79	1.18	76%	66%	87%
16. Lack of engagement and buy-in from multidisciplinary staff in ED is a barrier to COPD guideline adherence	3.47	0.9	69%	68%	71%
17. Referrals for non-pharmacological community management (pulmonary rehabilitation, smoking cessation, action plans, community support, self-management management and community support) from ED will avoid COPD readmissions and unnecessary inpatient admissions	3.95	0.91	79%	74%	84%
18. Provision of easier point of care resources from the guidelines will improve utilisation and uptake? (e.g. care pathways, concise guidelines, direct digital links to discipline related information)	4.26	0.81	85%	90%	80%
19. Time-efficient processes of care will enhance uptake of guidelines in ED	4.26	0.81	85%	78%	82%

(Continued)

Table 2 (Continued).

Barriers/ Enablers to Improve Guideline Adherence	Arithmetic Mean	Standard Deviation	Percentage of Agreement	ED POA	Resp POA
20. Cross-fertilisation of knowledge can be facilitated through discharge templates developed by specialty physicians (Respiratory) to improve interdisciplinary guideline adherence in ED	4	0.58	80%	80%	80%
21. Referral for non-pharmacological management and COPD action plan facilitated in ED by involving respiratory clinical nurses will improve guideline adherence	3.84	0.96	77%	74%	80%
22. Opportunity to access electronic data through COPD proforma will assist evaluation audits and future research to target areas of improvement	4.21	0.63	84%	86%	82%
23. Admission bundle with electronic prescribing system for COPD will provide consistent pharmacological management	4.11	0.66	82.2%	86%	78%
24. Automatic electronic linkage between hospital and community COPD services will reduce ED utilisation time	4.32	0.75	86%	90%	82%
25. Simple preformatted order sets (proforma) integrated into the electronic health record platforms will enhance guideline adherence in ED	4.16	0.69	83%	86%	80%
26. Dedicated acute exacerbation care proforma (checklist) in ED will improve pharmacological management adherence (bronchodilators, antibiotics, corticosteroids) in ED	4.16	0.69	83%	84%	82%
27. ED short-stay unit COPD digital proforma or care order sets to provide community and outpatient clinic referrals may reduce patient length of stay in hospitals	3.79	0.98	76%	76%	76%
28. Respiratory clinical nurses consulting their patients in ED to provide referrals and supportive community management will reduce length of stay, readmissions and remissions to inpatient departments	4.16	0.76	83%	82%	73%
29. Direct e-referrals through proforma from ED to primary care may improve guideline adherence, transition and provide management reminders for general practitioners	3.79	0.63	76%	76%	76%
30. Electronic COPD proforma will act as an educational aid to clinicians, interdisciplinary staff, and patients	4.11	0.46	82%	87%	78%

Abbreviations: ED, Emergency department; POA, Percentage of agreement; COPD, Chronic obstructive pulmonary disease.

services (75.8%), engagement and buy-in from multidisciplinary staff, clinical experience (70%), lack of respiratory skills (75.8%), and inaccurate prescription(s) (70%). Potential solutions with expert consensus of >70% included referrals for non-pharmacological community management from the ED, short-stay ED unit COPD digital proforma or care order sets to provide community and outpatient clinic referrals to reduce patient length of stay and avoid hospital admissions. Direct e-referrals through the proforma from the ED to primary care has prospects to improve guideline adherence, care transition, and provide clinical management reminders for general practitioners. Referral for non-pharmacological management and COPD action plan development or review facilitated in the ED has worth by involving respiratory clinical nurses. These nurses will facilitate consistent referrals and holistic care from acute settings back to the community.

Consensus below 70%, experts ranked and excluded were lack of knowledge (67.2%), awareness (68.6%), lack of resources based on publishing/updated years as reasons contributing to non-adherence (68.6%), and physiotherapy for sputum clearance in the ED (68.6%). Consistent agreement existed between the ED interdisciplinary staff for the specific ED section with clear recommendations of management, considering staff time/health services training time, ED staffing and capacity issues to manage co-morbidities being the key to improve guideline adherence in ED. Link information and internet dissemination possibilities between primary-care and hospital systems and community services exploration and implementation could potentially assist elevating guideline adherence. Clinicians and other interdisciplinary staff require to be informed how digital tools may assist and prescriptive guidelines and resources to utilise if necessary, while this

does not affect their own clinical reasoning and gestalt. Easy guideline referrals through clinician desktops and clinicians actively being involved in routine audits have potential to improve adherence.

Nursing and allied health experts recommended a user-friendly nurse-initiated referral system, improved electronic linkage between respiratory nurses and emergency department nurses and engagement with ED staff about their preferred methods of learning or adherence to clinical guidelines. Interdisciplinary education to all teams and easy access to this education, evidence-based treatment pathways for COPD management/prevention, mandatory training for ED nursing staff during orientation, education on referrals in nursing orientation packages were some implementation initiatives suggested by ED interdisciplinary staff. Increasing awareness among emergency staff on COPD pathway and linking the pathway to the patients when they present to triage followed by mandatory respiratory clinical nurse review or referral for further management will explicitly reduce chances of defragmented care for this cohort of patients when discharged from ED. Psychology and allied health experts (physiotherapist, pharmacist, and occupational therapist) suggested endorsement from physicians and nurses and other ED professionals that the guidelines do not undermine professional discretion and do not waste professionals' time are a key antecedent to buy-in from physicians, nurses, and other ED professionals. Frequent in-services for all allied health and multidisciplinary staff, with education outside clinical duty time to allow total comprehension is pivotal. Family and care-givers self-management and support modules with resources that clinicians could hand out on discharge will be an additional benefit to this cohort of patients and staff.

Iteration 2

Iteration 2 formed 13 indicators from iteration 1 and COPD X plan recommendations comprised the first draft of the electronic proforma (see [Supplementary File 1](#)). Qualitative analysis comprised three TDF domains (see [Table 3](#)). Multiple ED interdisciplinary staff voiced concerns regarding referral requirements from ED being too onerous and time consuming and the need for a single point of contact referral identified (*Environmental context and resources*). Explicitly both ED and respiratory staff agree that inhaler technique requires checking prior to discharge as this potentially becomes the most immediate reason for readmission with COPD patients (*knowledge*). All other referrals may be followed up in outpatient's clinic or community referrals may be provided by respiratory clinical nurse consultant (RCNC) as single point of ED referral facilitating registering ED discharges within the system (*environmental context and resources* and *social/professional role identity*). ED interdisciplinary staff implored mandatory RCNC review as a single point of contact could assist in accelerating guideline utilisation and community referrals for patients discharged from ED. Patients do not have to wait in the ED if they are well enough to be discharged, however, they must be admitted for multidisciplinary referral with mandatory RCNC referral for ED discharges (*social/professional role identity*). RCNC referrals from the ED will capture this cohort (ED discharges) in the system for later date follow-up or facilitation of community referrals. Inclusion of the integrated electronic medical records (ieMR) into hospital systems mean the possibility of direct referrals to primary care through ieMR smart referrals may be possible in the near future.²⁷ This is an area where future research is required on specific integration with primary-care partners.

Cronbach's alpha score for inter-rater reliability overall was 0.86 (ED: 0.85), Resp: 0.86) (see [Table 4](#)). High consensus indicators to be performed prior to ED discharge included respiratory nurse referral (Respiratory department consensus (RDC): 90%, Emergency department consensus (EDC): 84%), ED interdisciplinary staff (Doctors/Nurses/Physios/Pharmacist) inhaler technique assessment (EDC: 86%, RDC: 92.5%). ED discharge criteria (EDC: 86%, RDC: 85%) and community nurse or pharmacist referral for community medications and inhaler technique review (EDC: 75.5% and RDC: 85%) scored high consensus as this is an area mostly reported with fragmented care. This version significantly lacked mental health screening and assessments in the ED or any information relevant for anxiety/depression screening and referral for psychology and other needed allied health referrals as most of these patients have co-morbid anxiety/depression/existential considerations (*knowledge*). ED staff raised 75% consensus on having proforma accurately based on their discipline and requirements. ED discharge criteria consensus comprised clinical stability indicators revealing consistent consensus between both departments. Moderate consensus above 70% included community pharmacist or community respiratory nurse referral to check inhaler technique prior to ED discharge (EDC: 75.5%, RDC: 85%). Further clarity for the next iteration was requested by experts on reiterating guideline references for ABG, NIV, corticosteroid doses, and bronchodilator doses.

Table 3 Iteration 2 Qualitative Responses to TDF Domain and BCW

TDF Domain and Barriers E-ICP Version Iteration 2	COM-B	Recommended Intervention (BCW)	Expert's Quotes Recommendations
Knowledge Lack of inclusion of mental health care referrals Lack of referral pathways information Lack of understanding who and how to refer Lack of appropriate delegation of mental health screening Lack of specific dosage, blood gas/non-invasive ventilation references	Capability (Physical and psychological)	Training Modelling Enablement	R.D.1 Doctor: - "Significantly lacking any information relevant for anxiety/depression screening and referral for psychology and other needed allied health referrals" R.D.2 Doctor: - "Information brochure on smoking cessation to be given to patients and care givers by ED staff" R.D.2 Doctor: - "ED Discharge plans should include Smoking status Review status and implement smoking cessation strategies. Medication Reassess adherence and review inhaler technique. COPD Action Plan Review and discuss as appropriate. Ensure influenza and pneumococcal vaccinations are up to date. Pulmonary rehabilitation Ask about attendance and re-refer if necessary. Oxygen therapy Review need for long-term oxygen therapy (LTOT) in patients discharged from hospital on oxygen. Consider need for referral for additional services including peer support services Establish support required at home or place of residence" E.D.1 Doctor: - The ABG recommendation is not consistent with evidence or current ED practice. E.N.7 Nurse: - "It would be handy to include number of puffs via MDI for inhaled bronchodilators and Education and training of guidelines" E.N.7 Nurse: - "A printable patient information brochure to guide staff in their education, and that patient can take home and read" E.A. 2: - Pharmacist: - "I believe all interventions are necessary. Implementation of these and educating staff on carrying them out will be the biggest step" E.A. 2: - Pharmacist: - "Education is key. If a patient can understand the health benefits and how smoking cessation will significantly improve their disease state, they may be more open to quitting. Ongoing support with this is essential"
Environmental, context and resources Lack of clear ED section and instructions on discharge criteria Lack of staff time for health training services Lack of single point of contact referral Lack of embedded COPD resources in clinical area Lack of easier communication platforms between inter-disciplines Lack of easy-to-use referral systems from ED Lack of continuing medical records of care from primary care with existing diagnostics, baseline pulmonary function Lack of explicit treatment guidelines in the proforma Lack of delegation and clarity on who makes the referral	Opportunity (Social, Physical)	Environmental restructuring Persuasion Incentivisation	E.D.1 Doctor: "The ABG recommendation is not consistent with evidence or current ED practice. The referral requirements from ED are too onerous and time consuming. Some could be by GP. Being off oxygen at discharge is not a valid discharge criterion for a person on home oxygen. No mention of 3-minute walk test, ADL-related hypoxia - unlikely to cope at home. Salbutamol dose is low. Lack of detail about when NIV should be used e.g. pH level. Not all ED have access to pulmonary rehab etc." E.A.2: - Pharmacist: - "A video on this may assist with freeing up clinician time" E.D.1 Doctor: - "ED do not have time for extended counselling. Can raise the issue but GP is more appropriate" E.D.1 Doctor: - "Too much long-term care is being laid on ED - need to be more realistic" E.D.2 Doctor: - "FEV1 is difficult to do in ED - especially when patient acutely is unwell. Not realistic to base Diagnostics on this 2) ABG - really should read blood gas. The logic of having an arterial stab for people with adequate saturation" E.D.2 Doctor: - "mental health plan could be added. Most of these patients have co-morbid anxiety/depression/existential considerations" R.D.1 Doctor: - "Significantly lacking any information relevant for anxiety/depression screening and referral for psychology and other needed allied health referrals" R.D.1 Doctor: - "motivational interviewing/brief intervention provided by a psychologist with on-referral to continue with a psychologist" R.D.4 Doctor: - "COPD discharge template should include Smoking status Review status and implement smoking cessation strategies. Medication Reassess adherence and review inhaler technique. COPD Action Plan Review and discuss as appropriate. Ensure influenza and pneumococcal vaccinations are up to date. Pulmonary rehabilitation Ask about attendance and re-refer if necessary. Oxygen therapy Review need for long-term oxygen therapy (LTOT) in patients discharged from hospital on oxygen. Support services Establish support required at home or place of residence. Consider referral for additional professional support."

(Continued)

Table 3 (Continued).

TDF Domain and Barriers E-ICP Version Iteration 2	COM-B	Recommended Intervention (BCW)	Expert's Quotes Recommendations
			<p>E.N.1 nurse: - "Electronic easy access referral and Mandatory Respiratory CNC referral or review in ED"</p> <p>E.N.4 Nurse: - "if patients have pre-existing community or respiratory COPD management plans, that should be shared with ED on patient presentation via electronically or patient brings copy of the document would be beneficial in the treatment of COPD patients in ED"</p> <p>R.D.2 Doctor: - "Inhaled bronchodilators - might be easier to say salbutamol MDI 100 mcg 4 to 8 puffs etc., ipratropium would be MDI 21 mcg 4 puffs (this is not 80 mcg - needs correction in COPDX - would be 84 mcg but easier to say 21 mcg 4 puffs) Diagnostics - The arterial blood gases could be included within diagnostics, instead of a separate heading? Corticosteroids - in practice, 5 days is usually given (which is still within the up to 14 days)</p> <p>R.D.2 Doctor: - "Easy to use resources - timely, accessible, targeted, relevant, pragmatic"</p> <p>E.N.2 Nurse: - "Ideally ED should refer for physio and resp follow up - but i know in practice this does not always occur"</p> <p>R.N.1 nurse: - "This tends to be based on the resources of larger hospitals. It falls short when discussing rural and remote hospitals where there are no respiratory specialists- be it nursing or medical"</p> <p>E.A.3 Physio: - "May included high flow nasal prongs (HFNP) in oxygen management as FiO₂ is set with flow rates which can help with breathlessness in an acute exacerbation"</p> <p>E.A.3 Physio: - "Smoking Cessation dedicated position to support clinical staff at peak hours"</p> <p>E.A.3 Physio: "Check support plan and PR referral as clinically indicated. Consider at-home options if unable to attend group environment"</p>
<p>Social professional role identity</p> <p>Lack of clarification on role, what ED does and when speciality teams or primary care is involved</p> <p>Lack of respiratory interdisciplinary staff access in ED</p> <p>Lack of cross-fertilisation of knowledge between departments (ED and Resp) and interdisciplinary staff</p>	<p>Motivation (Reflective, Automatic)</p>	<p>Enablement Training Coercion</p>	<p>R.D.1 Doctor: - "mention re consideration of additional allied health referrals and reasons for this action plan smoking cessation vaccinations and all of the above"</p> <p>E.N.3 Nurse: - "GP referral for smoking cessation and thorough patient history and presentation including treatment and recommendations in discharge plan"</p> <p>E.D.1 Doctor: - "Is it the role of ED to tell GP what to do, Changes in care need to be flagged but long list is unlikely to be helpful"</p> <p>E.D.1 Doctor: - "ED do not have time for extended counselling. Can raise the issue but GP is more appropriate"</p> <p>E.D.2 Doctor: - "Most of these patients know that they need to stop smoking. I am unsure of the literature but could imagine this is best covered by GP or even psychologist as part of mental health plan"</p> <p>E.N.3 Nurse: - "I don't think we (ED) does the support services well. Linking is with GP for mental health care plan to access psychological support. Inhaler technique should be assessed each ED presentation, repetition helps with technique"</p> <p>R.D.4 Doctor: - "Checking on client motivation and knowledge."</p> <p>R.D.4 Doctor: - "GP referral to complete smoking cessation program"</p> <p>E.D.2 Doctor: - "It needs to be a trade-off between best evidence and feasibility. It can't be the case that a patient is waiting for 5 hrs in short stay to be discharged waiting for a physio, pharmacist, reps CNC etc. ideally should be a single contact"</p> <p>E.N.2 Nurse: - "It is a multi-disciplinary approach. ED is busy and we can't rely on the pharmacist or Resp nurse to do education. If they can great, but the ED nurses and doctors have a big part to play here"</p> <p>R.N.1 Nurse: - "I would suggest nicotine replacement therapy and also offer the support of a psychologist"</p> <p>R.A.3 Physio: - "patient's baseline dyspnoea, cough, and/or sputum should be established in ED to determine change during exacerbation follow up by respiratory clinical nurse and pulmonary rehab should be offered on discharge"</p> <p>E.A.2 Pharmacist: - "The below recommendations are all appropriate. Peer and mental health support should not be overlooked. Quitting smoking and managing COPD symptoms can be challenging for anyone"</p>

Abbreviations: TDF, Theoretical domains framework; COM-B, Capability, opportunity, motivation, behaviour; BCW, Behaviour change wheel; ED, Emergency department; COPD-X, Chronic obstructive pulmonary disease X plan; CN, Clinical nurse; ABG, Arterial blood gas; LTOT, Long term oxygen therapy; GP, General practitioner; FeV1, forced expiratory volume; R.D, Respiratory doctor; E.D, Emergency doctor; R.N, Respiratory nurse; E.N, Emergency nurse; R.A, Respiratory allied health professional; E.A, Emergency allied health professional; HFNP, High flow nasal prongs; PR, pulmonary rehab.

Table 4 Ed E-ICP Development Survey Iteration 2 Quantitative Responses

COPD E-ICP Content Confirmation: Iteration-2	Arithmetic Mean	Standard Deviation	Total Percentage of Agreement (POA)	ED POA	Resp POA
Cronbach's Alpha Score for Inter-Rater Reliability			0.849	0.721	0.828
Recommendations of care included in the proforma is accurate based on your discipline	3.56	0.81	71.2%	75%	70%
Respiratory nurse referral should be done before ED discharge for a later date follow-up	4.38	0.62	88%	84%	90%
Pulmonary rehabilitation referral to patient's closest Community location to be made by ED admin staff or interdisciplinary staff (Doctor, Nurse, physio) prior to ED discharge	3.3	1.1	66%	64%	80%
ED interdisciplinary staff (Doctors/ Nurses/Physios/ Pharmacist) should assess inhaler technique prior to ED discharge?	4.44	0.51	88%	86%	93%
ED discharge criteria may be <ul style="list-style-type: none"> • Clinically stable condition with no parenteral therapy • Inhaled bronchodilators are required less than four-hourly • Oxygen delivery has ceased If previously able, the patient is ambulating safely and independently, and performing activities of daily living. • The patient or care giver understands and is able to administer medications • Follow-up and home care arrangements in place (e.g. home oxygen, homecare, Meals on Wheels, community nurse, allied health, GP, specialist) 	3.94	0.85	79%	86%	85%
Community Pharmacist or Community Resp Nurse referral to be done to check inhaler technique prior to ED discharge	3.75	0.86	75%	76%	85%

Abbreviations: E-ICP, Electronic integrated COPD proforma; POA, Percentage of agreement; ED, Emergency department; COPD-X, Chronic obstructive pulmonary disease X plan; CN, Clinical nurse; Resp, Respiratory.

The results indicated implementation initiatives should be timely, accessible, targeted, relevant, and pragmatic. A smoking cessation dedicated position to support clinical staff at peak hours, if patients have pre-existing community or respiratory COPD management plans was included and shared with the ED on patient presentation either electronically or the patient bringing a copy of the document would be beneficial in the treatment of COPD patients in ED (*environmental context and resources*). Implementation of these and educating staff on procedural requirements will be the biggest step. This includes checking on interdisciplinary staff motivation and knowledge (self-learning modules). Ongoing support and videos for patient education may assist with freeing up clinician time (videos or self-learning modules for patients) (*knowledge and environmental context and resources*). Education and training for the COPD checklist (online), In services and self-learning modules/with refreshers potentially provided through the electronic proforma for all interdisciplinary staff (*environmental context and resources*). The discharge summary ideally should mention reconsideration of additional allied health referrals and reasons for this action plan, smoking cessation activities and liaison, vaccinations and pulmonary rehabilitation. Environmental barriers such as a lack of access to pulmonary rehabilitation, rural and remote hospitals where there are no respiratory specialists be it nursing or medical was raised by experts. Electronic proforma implementation was not always possible in rural and remote areas, however eventually we are moving towards a digital health-care industry (*environmental context and resources*).

Iteration 3

Qualitative thematic analysis imposed several themes such as forced expiratory volume (FEV1) referred to being driving investigations is not appropriate as almost universally not done/available in ED (*environmental context and resources*) (see Table 5). Performing FEV1 being difficult, and the accuracy of this step was questioned by experts to be performed in ED (*environmental context and resources*). Consensus existed between ED and respiratory clinicians that patients who still have an exacerbation or too unwell for spirometry do not require FEV1 performed in the ED, besides many EDs do not have functioning, well-calibrated spirometers. In the context of the modified Medical Research Council (mMRC) Scale not being relevant to ED as it does not address change in function from baseline during the exacerbation, consensus existed amongst both departments that mMRC may be utilised for assessment of breathlessness for initial assessment of severity, and then long-term management as an alternative in the absence of FEV1 data. ED clinicians expressed concern

Table 5 Qualitative Responses to TDF Domains Iteration 3

TDF Domain and Barriers	COM-B	Recommended Intervention (BCW)	Expert's Quotes Recommendations
Knowledge Lack of awareness of COPD-X guidelines Lack of innovative teaching resources such as patient videos, information brochures to free clinician education time in ED	Capability (physical and psychological)	Training Modelling Enablement	E.D.2 Doctor: - "The scoring for some criteria may need some explanation - ABG recommended for venous PH. There is no justification for ABG if VBG shows pH" E.D.1 Doctor: - "There is no justification for ABG if VBG shows pH" R.D.4 Doctor: - "The more interventions - including teaching videos - that patients can access for themselves - The better care will be"
Environmental, context and resources Lack of rural and remote services consideration or areas without intranet systems	Opportunity (Social, Physical)	Environmental restructuring Persuasion Incentivisation	E.N.4 Nurse: - "If chronic COPD patients presenting to emergency to carry some form of documentation (small cards etc.) mentioning their baseline lung function, FEV1, CO ₂ retainer, pressures normally used for NIV etc. would be beneficial for patients that are new or that do not have clear documentation" R.D.2 Doctor: - "Checking current smoking status or providing information brochures in ED" R.A.3 Physio: - "While a patient is going through an acute exacerbation of COPD a 3- or 6-minute walking test in ED might not be something they might be willing or capable of doing. Other factors to consider would be who performs the test and how formally the test is conducted, what information are we gathering i.e. do we have their baseline 6-minute walking test numbers to compare the current results with or if they do drop their saturation levels do we admit the patient" E.N.7 Nurse: - "Consider that ABGs may not be available in some settings (rural/remote). If the proforma is to be used across Australia, consider that not all states have Respiratory CNCs (may have Respiratory clinic); not all states may have access to the QLD smoking cessation pathway" R.N.1 Nurse: - "This is very comprehensive, but the assumption remains that the patient is in a hospital with suitable staffing. In rural and remote settings, there is very limited specialist e.g. respiratory CNC) or in some cases there is no regular GP- doctors may be on short contracts only. This proforma is excellent, but it would need to be delivered to all rural and remote areas to make it effective. Perhaps a learning tool and videos or a zoom session would be of benefit. The individual may get lost in the system. I would suggest dedicated remote learning packages and live sessions so that rural nurses know how to manage this as a doctor may not be available on site. This could be easily achievable. Associations such as CRANA would be ideal to promote this learning to rural and remote areas"

(Continued)

Table 5 (Continued).

TDF Domain and Barriers	COM-B	Recommended Intervention (BCW)	Expert's Quotes Recommendations
Social professional role identity Disagreements within interdisciplinary clinicians what ED can do versus what is expected COPD management Lack of cross-fertilisation of knowledge between departments, primary and tertiary care	Motivation (Reflective, Automatic)	Enablement Training Coercion	E.D.I Doctor: - This is not relevant to acute ED care. This is a GP/community care issues E.D.I Doctor: - "The mMRC Scale is not relevant to ED and it does not address change in function from baseline during the exacerbation. I very much doubt it will be used. 2. FEV1 is still referred to as driving investigations, this is not appropriate as almost universally not done/ available in ED.

Abbreviations: TDF, Theoretical domains framework; COM-B, Capability, opportunity, motivation, behaviour; BCW, Behaviour change wheel; ED, Emergency department; COPD-X, Chronic obstructive pulmonary disease X plan; E.D, Emergency department; R.D, Respiratory department; NIV, Non-invasive ventilation; FEV1, forced expiratory volume; pH, Potential of hydrogen ion; CN, Clinical nurse; ABG, Arterial blood gas; LTOT, Long term oxygen therapy; GP, General practitioner; R.D, Respiratory doctor; E.D, Emergency doctor; R.N, Respiratory nurse; E.N, Emergency nurse; R.A, Respiratory allied health professional; E.A, Emergency allied health professional; HFNP, High flow nasal prongs; PR, pulmonary rehab; CNC, clinical nurse consultant; QLD, Queensland; CRANA, Council of remote area nurses of Australia; mMRC, modified medical research council.

regarding justification for arterial blood gas (ABG) if venous blood gas (VBG) shows normal PH to which respiratory clinicians responded that ABG is not required unless chronic hypercapnia is suspected. High consensus existed between interdisciplinary staff that it would be beneficial if chronic COPD patients presenting to EDs carry some form of documentation mentioning their baseline lung function, FEV1, CO₂ retaining status, pressures normally used for NIV etc. as this would be beneficial for patients who are new or do not have any clear documentation (*knowledge/social/professional role identity*).

Iteration 3 comprised 9 indicators from the previous iterations of 13 indicators after exclusion of indicators that obtained less than 70% consensus (see [Supplementary File 2](#)). This iteration revealed Cronbach's alpha score EDC ($\alpha = 0.73$ [CI = 0.91%]) and RDC ($\alpha = 0.86$ [CI = 0.95%]) (see [Table 6](#)). Consensus >80% was achieved on bronchodilator doses (88%), corticosteroid doses (84%), NIV blood gas indicator references (84%), inhaler technique check prior to ED discharge (92%), respiratory CNC referral for community or outpatient's non-pharmacological management as single point of contact (EDC: 86% and RDC: 87%). Addition of high flow nasal prong therapy (HFNP) received consensus of 79% whilst other indicators that acquired consensus between 70–80% were modified Medical Research Council (mMRC) Dyspnoea Scale utility in the absence of FEV1 spirometry, ABG to be considered if VBG pH ≤ 7.34 in ED, patient self-learning videos (e.g., inhaler technique) to assist education in ED utilising digital resources. CAT mental health screening tool was highly recommended compared with other tools such as SGRQ questionnaire and HADS even though COPD-X plan suggests the latter. Low consensus below 70% and excluded indicators are Three minutes or Six minutes' walk test prior to discharge. All these changes were addressed in the final iteration of the proforma (see [Figure 2](#)).

Discussion

This study provided an opportunity to understand both Emergency and Respiratory departments' interdisciplinary staff perspectives on pragmatic feasibility of COPD guideline adherence. Prioritising indicators for acute exacerbation in ED and clarity on where to perform highly reported discordant indicators such as pharmacological/acute ED COPD management (bronchodilator dose, corticosteroid dose, antibiotic dose, ABG, NIV indication) and non-pharmacological indicators (smoking cessation, inhaler technique check, pulmonary rehab, self-management education, community and outpatient referrals). Our findings suggest a single point of referral contact prior to discharge will potentially increase guideline adherence and interconnect hospital and primary-care interdisciplinary support. Education and updated guideline requirements on treatment and management may be provided through an electronic platform by installing COPD E-ICP in the ED desktops and intranet systems. Installing resources for staff and patients will aid clinicians to provide consistent information to COPD patients and interdisciplinary staff despite their experience and knowledge in treating

Table 6 E-ICP Development Results Summary Iteration 3

COPD E-ICP Content Confirmation: Iteration 3	Arithmetic Mean	Standard Deviation	Total Percentage of Agreement (POA)	ED POA	Resp POA
Indicator 1 (oxygen management) may include high flow nasal prongs (HFNP) as FiO ₂ is set with flow rates which can help with breathlessness in an acute exacerbation	3.95	0.78	79%	74%	88%
Indicator 2 (Inhaled bronchodilators) dose is accurate to ED practice and COPD-X plan guidelines.	4.41	0.62	88%	84%	88%
Indicator 3 (Diagnostics): Modified Medical Research Council (mMRC) Dyspnoea Scale may be utilised to assess severity in the absence of FEV1 spirometry is acceptable clinical practice	3.68	1	73%	72%	75%
Indicator 3 (Diagnostics): Venous blood gas (VBG) for all COPD patients and arterial blood gas (ABG) to be considered if the VBG pH ≤ 7.34 in ED	3.79	1.23	76%	70%	83%
Indicator 4 (corticosteroids): Oral corticosteroids for 5 days and up to 14 days (prednisolone 40–50 mg daily) dose is consistent with current practice in ED and COPD guidelines	4.22	0.73	84%	86%	82.3%
Indicator 6 (Non-invasive ventilation): NIV for increasing hypercapnia and acidosis (ABG with a PaCO ₂ above 45 mmHg and a pH less than 7.35) is consistent with current practice in ED and COPD guidelines?	4.22	0.94	84%	82%	87.3%
Indicator 7 (ED discharge criteria): Three minutes or Six minutes' walk test is recommended prior to discharge?	3.33	1.28	67%	76%	55%
Indicator 7 (ED discharge criteria): Inhaler technique is highly recommended to be assessed by ED clinician or a nurse due to the risk of readmission or acute exacerbation?	4.61	0.5	92%	90%	95%
Indicator 9 (Respiratory CNC referral) is recommended for all COPD ED discharges as single point of contact for follow-up and community referrals?	4.28	0.96	86%	82%	90%
Indicator 9 (Respiratory CNC referral): Mental health screening utilising (a) Hospital anxiety and depression scale (HADS), (b) COPD assessment tool (CAT) or (c) St. George's Respiratory questionnaire (SGRQ) may be facilitated via outpatient clinic or community referral for psychological assessment and support?	4	1.19	80%	78%	83%
Nonpharmacological management (Pulmonary rehab referral, Smoking cessation, self-manage action plans) may be initiated in OPC or referral by resp CNC to community GP will suffice to address ED discharged patients?	4.33	0.69	87%	82%	93%
Patient self-learning videos (e.g. inhaler technique) will assist education in ED utilising mobile devices such as iPad or other mobile devices?	3.89	1.23	78%	78%	78%

Abbreviations: COPD, Chronic obstructive pulmonary disease; E-ICP, Electronic integrated COPD proforma; POA, Percentage of agreement; HFNP, High flow nasal prongs; FiO₂, fraction of inspired oxygen; ED, Emergency department; NIV, Non-invasive ventilation; ABG, Arterial blood gas; PaCO₂, partial carbon-dioxide; CNC, Clinical nurse consultant; OPC, outpatient clinic.

Emergency Department electronic Integrated COPD care proforma (e-ICP) Triage to discharge	
1) Oxygen therapy	<ul style="list-style-type: none"> Maintain oxygen saturation of 88-92% (Use nasal prongs at 0.5–2.0 L/minute or a Venturi mask at 24% or 28%)
2) Inhaled bronchodilators	<ul style="list-style-type: none"> Short acting bronchodilators [dose interval is titrated to the response and can range hourly to six hourly] Inhaled beta-agonist [Salbutamol MDI 100 mcg (4 to 8 puffs), Ipratropium MDI 21 mcg (4 puffs)] Jet nebulisation (Salbutamol, 2.5–5 mg; Terbutaline, 5 mg; Ipratropium, 500mcg)
3) Diagnostics	<ul style="list-style-type: none"> Modified Medical Research Council (mMRC) Dyspnoea Scale to assess severity in the absence of FeV1 In case of FEV1 < 40% predicted perform: COPD severity score, blood gas measurements, chest x- rays and electrocardiography (spirometry recommended if patient is stable) ABG recommended if the VBG pH \leq 7.34 (ABG not required unless chronic hypercapnia is suspected)
4) Corticosteroids	<ul style="list-style-type: none"> Oral corticosteroids for 5 days and up to 14 days (prednisolone 40–50 mg daily)
5) Antibiotics	<ul style="list-style-type: none"> Antibiotics are recommended for purulent sputum only to cover for typical and atypical organisms.
6) Non-Invasive Ventilation	<ul style="list-style-type: none"> NIV for increasing hypercapnia and acidosis (ABG with a PaCO₂ above 45mmHg and a pH less than 7.35)
7) ED discharge criteria	<ul style="list-style-type: none"> Clinically stable condition with no parenteral therapy Inhaled bronchodilators are required less than four-hourly Inhaler technique assessed by ED clinician or a nurse Oxygen delivery has ceased unless patient is on home oxygen If previously able, the patient is ambulating safely and independently, and performing activities of daily living (3–6-minute walk test recommended) The patient is able to eat and sleep without significant episodes of dyspnoea The patient or caregiver understands and is able to administer medications
	<ul style="list-style-type: none"> Follow-up and home care arrangements (e.g.: home oxygen, homecare, Meals on Wheels, community nurse, allied health, GP, specialist)
8) ED discharge template to primary care or OPC	<ul style="list-style-type: none"> Discharge summary template for convenience (will be linked electronically) Provide COPD patient information pack by Lung foundation Australia (will be linked electronically) All AECOPD ED discharges are highly recommended to have Respiratory CNC referral (Direct electronic referrals from ED will be linked here)
9) Resp Nurse outpatients clinic (OPC) referral	<ul style="list-style-type: none"> Referral to follow up in the outpatient clinic or community referrals to be provided to primary care GP Pulmonary rehabilitation should be offered to patients with COPD following hospitalisation for an AECOPD within 2 weeks Initiate Queensland smoking cessation pathway Health related quality of life assessment using Hospital anxiety and depression scale (HADS), COPD assessment tool (CAT) or St. George's Respiratory questionnaire (SGRQ) GP referral for COPD action plan, self-management, and immunisation

Figure 2 E-ICP final version for implementation in the Emergency department.

respiratory patients. Our findings also suggest due to lack of patient and primary-care history, staff would really appreciate transfer of self-management plans, and action plans that are accessible by ED clinicians. Clinical informatics and digital assistance in the clinical environment have escalated guideline adherence and improved patient HRQoL.²⁷ There is a level of disagreement between COPD guidelines and what is feasible in the emergency department, for instance clinician discretion on performing ABG or utilising NIV. Interestingly, GOLD guidelines suggest performing spirometry during the acute stage, however COPD-X guidelines do not make such restrictions.²⁸ FEV1 still is the standard gold diagnostic investigation to assess severity and lack of clarity exists within international and national guidelines on diagnostics in the ED. Lack of availability of spirometry results in the emergency department were suggested to be tackled by utilising modified Medical Research Council (mMRC) dyspnoea scores and cigarette

smoking/smoke exposure assumption in ED which had minimal consensus by both ED and respiratory department clinicians which is an area that needs further research.^{25,29} Interdisciplinary staff consistently agreed upon COPD patients bringing forward documentation with their last baseline pulmonary function measures in primary care to assist with early identification of probable hypercapnic respiratory failure.

Contrary to the exploratory review findings, experts ranked low consensus and excluded lack of knowledge (67.2%), awareness (68.6%), lack of resources based on publishing/ updated years as reasons contributing to non-adherence (68.6%).^{9,30–33} A substantial difference was noted between ED and respiratory staff with referrals to be made by ED staff in the initial iterations of this study, however consensus was obtained by having a single point of contact (respiratory CNC referral) by both cohorts as time, staffing and pragmatic challenges were noted. Lack of consensus was apparent between ED clinicians and respiratory clinicians in terms of utilising ABG over VBG pH ≤ 7.34 and NIV criteria in ED as per COPD -X plan guidelines which indicates pragmatic dissemination to improve knowledge of COPD X guidelines is inevitable. Summarising the indicators of care in ED and referrals being managed by a single point of contact to respiratory clinical nurse the proforma will provide consistent guideline adherence and capture ED discharges for continuous care.^{5,25} The electronic proforma will be potentially capable of facilitating chronic care support appropriately through community or outpatients referrals. Electronic proformas are only feasible in larger hospitals with intranet resources and fall short when discussing rural and remote hospitals where there are no medical or nursing respiratory specialists. More work and research are required in this space particularly with the use of telehealth and internet dissemination into the primary-care area. This also falls under the strength of this study as nationally there is migration towards digitalisation from paper utilising integrated electronic medical records which increases the feasibility of the electronic COPD proforma.³⁴ Mandatory respiratory CNC referral potentially increases continuity, accountability, and defragmentation of care. Dedicated and holistic bundles of care have proven to improve care and guideline adherence in studies in the UK, Australia, and Ireland,^{15,35,36} hence we presume adopting electronic COPD proforma will facilitate the same for Australia and other countries of similar health-care systems.

Conclusion

Variability in utilisation of COPD guideline recommendations by interdepartmental/interdisciplinary staff may be mitigated by utilisation of the electronic proforma. Through different iterations of this study, we have developed COPD care indicators to be initiated in the ED and primary-care referrals facilitation utilising a single point of referral (respiratory nurse specialist). This proforma will aid to resolve major barriers of knowledge, environmental resources, and professional role clarity in the management of COPD patients in the ED. Further research is warranted to explore alternatives for diagnostics and management in the ED due to unavailability of baseline pulmonary function scores during acute exacerbation episodes. Further research is also recommended to pilot the electronic COPD proforma in clinical settings to evaluate its impact on knowledge, guideline dissemination and impact on patient outcome in terms of holistic support.

Abbreviations

COPD, chronic obstructive pulmonary disease; E-ICP, electronic integrated COPD proforma.

Ethics

Ethics were reviewed and approved by University of Southern Queensland (H21REA007). All participants were provided research participation information sheet and consent obtained prior to each iteration completion.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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