REVIEW

Clinical Management of COPD in the Real World: Can Studies Reveal Errors in Management and Pathways to Improve Patient Care?

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Abstract: Real world data comprise information on health care that is derived from multiple sources outside typical clinical research settings. This review focuses on what real world evidence tells us about problems with the diagnosis of chronic obstructive pulmonary disease (COPD), problems with the initial and follow-up pharmacological and non-pharmacological management, problems with the management of exacerbations and problems with palliative care. Data from real world studies show errors in the management of COPD with delays to diagnosis, lack of confirmation of the diagnosis with spirometry, lack of holistic assessment, lack of attention to smoking cessation, variable adherence to management guidelines, delayed implementation of appropriate interventions, under-recognition of patients at higher risk of adverse outcomes, high hospitalisation rates for exacerbations and poor implementation of palliative care. Understanding that these problems exist and considering how and why they occur is fundamental to developing solutions to improve the diagnosis and management of patients with COPD.

Keywords: COPD, real world studies, diagnosis, pharmacotherapy, exacerbations, palliative care

Introduction

The development of evidence-based guidelines provides frameworks and the availability of effective pharmacological and non-pharmacological therapies provides tools that have the potential to improve outcomes for patients with chronic obstructive pulmonary disease (COPD).[1] However, there is evidence that the management of COPD in primary and secondary care is sub-optimal, with late diagnosis, variable adherence to guidelines, delayed implementation of appropriate interventions, poor identification of patients at higher risk of adverse outcomes and under-recognition of comorbidities.[2,3] Understanding how COPD is managed in the real world and identifying opportunities to improve this is essential if we are to improve outcomes for patients.

The term "real world data" refers to information on health care that is derived from multiple sources outside typical clinical research settings, including electronic health records (EHRs), claims and billing data, disease registries, and data gathered through surveys, personal devices and health applications.[4] Studies based on real world data reveal how COPD is managed, and how effective pharmacological and non-pharmacological therapies are when used in routine practice. They can also examine different patterns of care within populations by geography or over time and be used to make inferences about the impact of those care patterns on patient and disease outcomes. Findings from real world studies are now also accepted as important in the development of clinical guidelines.[5,6]

Real world data have limitations that are important to recognise and understand. They are much more likely to be impacted by confounding bias and the existence of unmeasured confounders can never be completely ruled out. Real world data on the management of a specific disease such as COPD are also affected by the accuracy of the diagnosis – if people who do not have COPD are misdiagnosed and included in studies the validity of the findings can be questioned. The robustness of real world studies using EHRs also depends on the quality of the data entered. The primary purpose of EHRs is to help clinicians deliver patient care and most information is entered as unstructured free text, particularly when

time is short.[7] High quality data suitable for use in real world studies require structured coding but this is often done by non-clinical staff and coding of evolving symptoms and diagnostic uncertainty is challenging and may be shaped by both unconscious and conscious drivers.[8] Issues with coding poses many problems for research based on EHRs.

This review will illustrate how real world data can reveal errors in the day to day management of COPD and how addressing these can improve outcomes for patients. It will not attempt to summarise all the real world data that are available on management and outcomes, a task that would be unmanageable, rather it will focus on specific aspects of COPD management and use examples to illustrate how real world data can be used to identify problems and assess the effectiveness of interventions designed to overcome them. The review will focus on what real world evidence tells us about problems with the diagnosis of COPD, problems with the initial and follow-up pharmacological and non-pharmacological management, problems with the management of exacerbations and problems with palliative care.

Real world data complement the assessment of the effectiveness of pharmacological and non-pharmacological therapies outside the rigours of efficacy of randomised control trials (RCT) with their interventions delivered according to strict protocols and homogeneous populations that exclude many real-world patients.[9] In COPD there is growing interest in real world evidence, including prospective, randomised, pragmatic trials, to assess the effectiveness of therapies.[10,11] Real world data may or may not confirm treatment effects observed in RCTs. The importance of real world data is also recognised by both the US Food and Drug Administration (FDA) and the European Medicines Agency (EMA)[12,13] and real world data are now being considered as part of the regulatory process for new therapies.[14] However, real world effectiveness studies are outside the scope of this review, which focuses on what real world data tell us about the management of COPD.

Diagnosis

Delayed diagnosis and under-treatment of COPD result in a significantly higher risk of exacerbations and hospitalisation.[15] An analysis of UK real world data between 1990 and 2009 showed that opportunities to diagnose COPD were missed in both primary and secondary care during consultations for respiratory symptoms, including breathlessness and cough, consultations for lower respiratory infections and consultations that led to ordering of a chest radiograph. Eighty-five per cent of patients had had one or more missed opportunity in the 5 years prior to the diagnosis of COPD and in many cases, opportunities were missed for more than 5 years before diagnosis.[2] When eventually diagnosed, patients had lost a significant amount of their lung function, with 42% having a forced expiratory volume in 1 second (FEV_1) less than 50% of their expected value at the time of diagnosis.

Analysis of more recent English primary care real world data has shown that opportunities to identify patients at high risk of poor outcomes (defined as patients who had had ≥2 moderate or ≥1 severe (i.e., requiring hospitalisation) COPD exacerbations in the previous 12 months) are also being missed.[16] These patients comprise around one third of the total COPD population. The data show that the median interval between diagnosis and becoming high risk was just over 2 years, but over a third of patients (35%) were high-risk for many years prior to receiving a COPD diagnosis.[16] The same study showed that in 2019, the most recent year analysed, over 40% of newly diagnosed patients had not had spirometry recorded in the previous year. Studies in other countries such as Wales, Denmark, Sweden, Korea and the USA,[17–21] have also shown poor levels of confirmation of the diagnosis with spirometry. Disappointingly, the English data also showed that, despite dissemination of national and international guidance, there had been a decline in the proportion of patients who had had spirometry at diagnosis in recent years.[16] There is also evidence of significant misdiagnosis with, for example one in four patients diagnosed with COPD in Wales having incompatible post-bronchodilator spirometry (FEV_1/Forced Vital Capacity (FVC) ≥ 0.70).[17]

Real world data from a survey of patients in the UK confirm the problems with delays to diagnosis. The majority of respondents (58.1%) had waited a year or less for a diagnosis after first noticing symptoms; however, 12.4% waited more than 10 years.[22] Patients reported a number of reasons for the delays including difficulty in getting appointments (in 26% of cases), General Practitioners (GPs) attributing symptoms to infections (23%), diagnostic tests not being available (21%), initial misdiagnosis (16%) and new symptoms being dismissed by GPs when first reported (7%).

In the study of English patients, in the most recent year of analysis most newly diagnosed high-risk patients with COPD had not had an exacerbation history review (58%) or COPD Assessment Test (CAT) assessment (75%) at the time

of diagnosis to guide initial therapy.[16] An audit of primary care management of COPD care in Wales showed 40% of patients had not had a Medical Research Council (MRC) breathlessness score, 84% of the patients had not had their FEV$_1$ as a percentage of the predicted value recorded in the previous 12 months,[23] and 58% of patients had no indication of exacerbation frequency in the previous 12 months.

Real world data show that comorbidities, particularly diabetes, hypertension, ischaemic heart disease, and anxiety and depression are common at the time of diagnosis,[3] and contribute to worse symptoms and worse outcomes. However, in the real world patients already at high risk of poor outcomes at diagnosis are not being assessed for the presence of undiagnosed comorbidities.[16]

The real world data show that there are delays to making the diagnosis, inadequate use of spirometry to ensure the diagnosis is correct and a lack of risk stratification and holistic assessment at the time of diagnosis. Correcting these errors presents clear opportunities to improve COPD management.

Management of Stable Disease

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2023 Report identifies aims for the management of COPD that include reducing symptoms and the risk of exacerbations as well as preventing disease progression and mortality.[1] The report makes recommendations for initial and follow-on pharmacological and non-pharmacological interventions to achieve these aims. Similarly, the National Institute of Health and Care Excellence (NICE) guidelines for diagnosis and management of COPD in England set out five fundamentals of COPD care. These related to treatment and support to stop smoking, vaccination, pulmonary rehabilitation personalised self-management plans and managing comorbidities, as well as inhaled therapies to relieve breathlessness or exercise limitation.[24] Real world studies have looked at whether patients are treated according to these recommendations.

Smoking Cessation

Nearly half of patients in the UK initiating maintenance therapy were still smoking[3] and there is little evidence about when and if smoking cessation advice is offered in a timely way to newly diagnosed patients. Real world data from primary care in Ireland showed that 71% of eligible COPD patients had been offered smoking cessation advice,[25] yet only just over half of smokers reported having been offered treatment and support to stop smoking in the patient survey.[22] Real world data from the US have shown that seven in ten patients with COPD who smoked cigarettes made an attempt to quit smoking within the previous 12 months, but fewer than one in twenty reported successful cessation - a worse success rate than people without COPD.[26] Real world data from Germany have also shown that only a few COPD patients use evidence-based methods as assistance for quitting.[27] A survey study of smoking behaviour in patients with COPD in Spain found that those who smoked were more likely to smoke more heavily (>30 pack years) and have higher nicotine dependence than their counterparts without COPD[28] and COPD patients who continue to smoke have low self-efficacy,[29] perhaps explaining the problems patients have with quitting and the need for help. Studies have investigated clinicians' approaches to smoking cessation in COPD and the reasons for not offering treatment which include frustration with patients who continue to smoke; limited knowledge of, and negative beliefs about, smoking cessation treatment; and organisational factors such as money and time.[30]

The real world data clearly show that more needs to be done to support patients with COPD to stop smoking.

Initial Pharmacotherapy

A real world study in Germany showed that the median time to initiation of any inhaled maintenance therapy after diagnosis was 4.4 months, but 44% did not receive any maintenance treatment in the first 12 months after diagnosis and even after 3 years 36% were still not prescribed a maintenance therapy.[31] Patients who did not receive maintenance therapy were older, more likely to be female, had less severe reduction in FEV$_1$ and had more comorbidities. However, even among patients with severe airflow limitation (FEV$_1$<50% predicted), about one third did not receive at least one prescription for inhaled maintenance therapies. Over 80% of patients not prescribed maintenance treatment were also not prescribed short-acting bronchodilators. Patients first diagnosed in hospital were found to have a lower rate of COPD treatment (45.3%) than patients initially diagnosed by outpatient pulmonologists (80.3%).[31] Patients not prescribed

maintenance therapy were more likely to die in the first year after diagnosis than those who were treated (27.3% versus 10.8%). In the UK, 21% of newly diagnosed high-risk patients did not receive any respiratory therapy in the year after diagnosis.[16]

When the appropriateness of initial pharmacotherapy therapy in the UK was compared with GOLD recommendations, two thirds of patients in groups A and B (i.e., at lower risk of exacerbations) were prescribed appropriate treatment but one third were over-treated, predominantly because of the prescription of inhaled corticosteroids (ICS), although some of these patients may have had asthma as well as COPD.[3] ICS are only indicated as part of initial therapy for COPD if patients have already had frequent or severe exacerbations and have blood eosinophil count > 300 cells/μL.[1] Similar findings have been seen in the US and Spain, with more patients received ICS-containing therapies than would be expected based on their exacerbation history.[32,33] Among patients at risk of exacerbation in the UK (previously GOLD groups C & D, now GOLD group E) 16% were initially under-treated.[3] A database study of the initiation of triple therapy (either in multiple or single inhalers) showed 64% of patients were over-treated and had no evidence of ≥ 1 severe or ≥ 2 moderate exacerbations before initiating triple therapy.[34]

Real world data on initial pharmacotherapy show delays in starting therapy and errors in management, with over-prescription of ICS – exposing patients to unnecessary risk of side effects.

Follow-Up Pharmacotherapy

Many real world studies have looked at the prescription of follow-up pharmacotherapy and assessed the appropriateness of this with relation to guideline recommendations.[35–38] These studies have shown a higher use of ICS and under-prescription of bronchodilators than expected based on the recommendations.[35,39–43] However, their interpretation is limited by the fact that they have not considered the exacerbation risk and symptoms burden at the time the therapy was prescribed and the fact that some patients may have responded well to therapy and reduced the level of their symptoms, had fewer exacerbations or both, resulting in erroneous conclusions about the appropriateness of their therapy.

Most studies have also not looked at the appropriateness of follow-up therapy in relation to blood eosinophil counts. In one study that has taken account of eosinophil counts there appeared to be substantial over-treatment of patients with blood eosinophil counts < 100 and those with higher eosinophil counts with mMRC < 2 and fewer than 2 exacerbations in the previous year.[3] Symptomatic patients with mMRC of 2 or more and those with frequent exacerbations appeared under-treated irrespective of eosinophil counts. Another real world study has also shown that ICS prescription does not follow recommendations with regard to blood eosinophil counts.[44]

GOLD recommends a continuing cycle of assessing, reviewing and adjusting therapy[45] but in the analysis of high-risk patients in England, only just over half of patients had a review of their medication within 6 months of initiating or changing therapy. The real world data on the appropriateness of maintenance therapy two years after initiation of therapy showed that for patients initially in group A there was an equal tendency both to increase treatment in approximately 25% of those appropriately treated at baseline, and de-escalate in 25% of those over-treated at baseline. A similar pattern was seen in group B, but 11% of patients who were over-treated at baseline were de-escalated to therapy that appeared to leave them under-treated.[3] Patients initially in group D who were under-treated initially were either appropriately treated at follow-up (43%) or over-treated (57%).

Real world data looking at the effects of following guidelines on outcomes found that only 36% of patients were prescribed GOLD-adherent pharmacotherapy; however, as discussed above the study did not look at the clinical characteristics at the time of prescription. Nevertheless, compared with patients whose treatment was adherent with GOLD recommendations, COPD-related symptoms, all-cause hospitalisations and emergency department visits as well as respiratory-specific ED visits were significantly higher in patients with GOLD-nonadherent therapy. When patients receiving GOLD-nonadherent treatment were categorised as under-treated and over-treated patients, under-treatment was associated with significant increases in many COPD symptoms, and both under-treatment and over-treatment were associated with increased healthcare resource utilisation.[46] More recent real world data, again with the caveat about appropriateness at initiation, also show that being on GOLD guideline-noncompliant regimens significantly increased the risk of exacerbation compared with compliant regimens.[47] GOLD-compliant regimens were observed in 32.9% of

patients in the GOLD A/B group and in 58.9% of patients in the GOLD C/D group, with ICS-containing regimens being the most common noncompliant regimens.

Real world data looking at patients whose treatment was escalated from a long-acting muscarinic antagonist (LAMA) to triple therapy (LAMA + long-acting β-agonist-ICS) showed that exacerbations were the main factor associated with escalation; however, lower FEV_1, MRC grade, specialist, cough, and number of short-acting bronchodilator prescriptions were also associated with escalation, whilst being older, or a current/ex-smoker were negatively associated with escalation.[48] Real world data also show that delays in the initiation of appropriate therapy are associated with worse outcomes. Promptly initiating triple therapy after two moderate or one severe exacerbation is associated with decreased risk of future exacerbations and lower costs.[49,50]

Real world data show errors in management, with over-prescription of ICS in patients unlikely to benefit and suggest that clinicians are over-treating many patients in response to clinical features that do not prompt escalation according to guidelines but delay in escalation when appropriate. The real world data also show that errors in follow-up management correlate with worse clinical outcomes.

Non-Pharmacological Interventions

In the UK only half of patients reported being offered pulmonary rehabilitation (PR) if indicated[22] and 66% of newly diagnosed high-risk patients had not been offered or received a referral for PR.[16] In Germany only 34% of COPD patients reported ever having participated in an outpatient or inpatient PR programme.[51] Patients that were older, female, more deprived, or had a comorbidity of diabetes, asthma, or painful condition had significantly lower odds of referral to PR.[52]

Real world data from primary care in Ireland showed that only 66% of patients had received an influenza vaccination in the previous 12 months and only 54% had ever had a pneumococcal vaccine.[25] Similar rates of influenza vaccination were found in US veterans and in Germany and Spain,[51,53,54] but influenza and pneumococcal vaccination rates were much lower in Turkey.[55] Slightly lower rates of influenza vaccination were seen in younger patients in Greece[56] and in patients with lower FEV_1 in Spain.[54] Data from Korea showed a significant fall in influenza vaccination rates between 2007 and 2018 in younger patients with airflow limitation, and overall younger patients, men and current smokers were less likely to be vaccinated.[57]

Real world data again show basic deficiencies in management that must be addressed. Education on COPD management/guidelines to both general practitioners and nurses/practice assistants has been shown to significantly improve influenza vaccination rates although it had little impact on pneumococcal vaccination.[58] It is essential that professionals are aware of the importance and benefits of vaccinating COPD patients against influenza, pneumococcus, COVID-19, pertussis and herpes zoster.[1]

Self-Management

Very limited data have been published in the proportion of patients with COPD who have been given self-management advice. In a Swedish registry study 22% of patients had participated in a patient education programme with higher participation rates in women.[59] Participation rates were higher overall in Germany (40%) but again participation was higher in women than in men (43% vs 35%).[51] In the UK only 32% of patients reported having a self-management plan and only 60% of patients with a plan reported that they had been involved in its creation.[22] In a separate analysis of self-reported data from diagnosed COPD patients in Birmingham only 40% had self-management plans and 50% reported never having received advice on diet or exercise. Self-management interventions are associated with improvements in health-related quality of life and a lower probability of respiratory-related hospital admissions.[60] The limited real world data available show that the proportion of patients with self-management plans is too low and needs to be increased significantly.

Use of Inhalers

Guidelines emphasise the importance of educating and training patients, as well as healthcare professionals (HCP), in the correct use of inhaler devices. GOLD states that regular assessment at follow-up is necessary to maintain effective use of

inhalers[45] but many studies have shown that patients frequently make errors using their devices.[61] Real world data show that patients are much more likely to worry about the effectiveness of their COPD medication than the proper use of their device with two thirds stating that they were never concerned about their device technique.[62] When patients were asked to rate their confidence that they were using their inhaler correctly, 30% overestimated their ability relative to their physician's rating.[63] A study of patients in nine countries (Brazil, Canada, France, Germany, Italy, Japan, the Netherlands, UK and USA) found that 29% had not had their inhaler technique checked by a HCP within the last two years.[64] Patients who had had their inhaler technique checked were significantly more adherent to their therapy than those who had not had it checked.

A real world study in the community assessed whether patients prescribed dry powder inhalers had sufficient inspiratory flow to obtain optimal drug deposition. Twenty-nine per cent were not able to generate sufficient inspiratory flow, and these patients had worse health status than those who were able to use their inhaler.[65] A similar study of hospitalised patients showed 45% had a sub-optimal inspiratory flow for the device they had been prescribed.

Ensuring patients can use the inhaler device they are prescribed is a fundamental requirement of COPD management but does not appear to be happening. Opportunities are being missed to ensure inhaler technique is correct and to prescribe inhalers that patients can use, in order to optimise the effects of inhaled therapy.

Exacerbations

There is a paucity of evidence on the appropriateness of management of exacerbations in the community. Real world data on the management of patients hospitalised for an exacerbation of COPD in the UK show that 4% died during the admission, 6% died within 30 days and 12% died within 90 days of the admission, principally because of COPD.[66] At the time of admission 36% of patients were still smoking. Comorbidities were common: 40.0% of patients had a history of cardiovascular disease and 16.6% had a history of mental illness. New interventions were made in 20.9% of those with cardiovascular disease and 13.6% of those with mental illness.

Spirometry results were available in half of the patients admitted in the UK, and of these one in eight did not have airflow obstruction ($FEV_1/FVC \geq 0.7$) indicating errors with diagnosis.[66] An earlier study of the care that patients received in the community prior to being hospitalised for an exacerbation showed that in 11% of cases patients had not been diagnosed with COPD prior to their admission.[67] Overall, the patients hospitalised had had a median of eight contacts with, or visits to, the practice in the 12 months before admission, including a median of one in the 4 weeks before admission. Thirty-one per cent of patients had attended their GP's surgery three or more times in the 4 weeks prior to hospital admission and 74% of all patients had been seen at least once in the month prior to admission; suggesting that there were opportunities for intervention that may have prevented admission or reduced the severity of exacerbations.[67] One third of patients hospitalised had not been reviewed in a primary care COPD clinic during the previous 12 months.[67]

The 2019 data showed that during the admission 28% did not have their inhaler technique checked, 41% were not provided with a self-management plan and 38% were not assessed for suitability for pulmonary rehabilitation.[66] In the European COPD audit of clinical care in 384 hospitals from 13 European countries between 2010 and 2011 86% of patients were given antibiotics but only 61.4% cases met the GOLD recommendations.[68] Patients cared for on a Respiratory Ward were more likely to receive GOLD compliant antibiotic management, suggesting lack of specialist knowledge may account for variations from guideline recommendations. In the UK data, 64% of patients hospitalised with an exacerbation were prescribed oxygen and 10% required non-invasive ventilatory support, but in over 60% of cases this was started more than 2 hours after admission.[66]

Readmissions following hospitalisation are common, and in some cases may reflect a failure in discharge planning or management of the exacerbation, particularly when they occur within a few days of discharge. In one real world study in the USA over 15% of readmissions occurred within 3 days of discharge.[69] In the UK 24% of patients were readmitted within 30 days and 43% within 90 days after discharge, with COPD accounting for 40% of readmissions.[70] In other parts of the world 30-day readmissions appear lower[69,71,72] and are 6.7% in New Zealand.[73] In data from the USA over half of readmissions occurred within 2 weeks of discharge,[69,74] meaning that planning to follow-up a patient more than 2 weeks post-discharge would miss those most at risk. Moreover, identifying patients at risk of readmission is difficult and there the limited variation in readmission rates between hospitals has been taken to suggest there is little opportunity to

improve management.[75] However, real world data from Southampton in the UK found that 6% of patients had been admitted three or more times in the previous 12 months and these patients accounted for 22% of total COPD admissions.[76] Following a programme to improve the management of these patients their admission rates fell to nearly a fifth of the previous rates and the overall hospital 30-day readmission rate dropped from 13.4 to 1.9%, demonstrating how important it is not to ignore high-risk patients.

Palliative Care

Palliative care has much to offer for people living with advanced COPD and includes more than just terminal care. It involves approaches to symptom control, emotional support for patients and the people close to them, and planning future care through advance directives.[77,78] The GOLD report recommends "that all clinicians managing patients with COPD should be aware of the effectiveness of palliative approaches to symptom control and use them in their practice".[45] However, real world data from the UK between 2004 and 2015 showed only one in five people dying from COPD in the UK were recorded as having received any palliative care.[79] Just under half of those that did get palliative care only received it during the last 6 months of their life and one third only in their last month of life. US real world data showed a similar picture.[80] The underuse of palliative care was first reported over 20 years ago[81] but it seems that despite national and international guidelines encouraging its use in the real world most patients do not receive palliative care.[82]

Conclusions

COPD places a high burden on individuals, healthcare systems and society. In 2019, 212.3 million cases of COPD were reported globally, and COPD accounted for 3.3 million deaths and 74.4 million disability-adjusted life-years (DALYs),[83] making it the third commonest cause of death and in the top four causes of DALYs in people over 50 worldwide.[84] Real word data show that errors in management are common and key opportunities to improve outcomes for patients with COPD are being missed. The data show delays to diagnosis, lack of confirmation of the diagnosis with spirometry, lack of holistic assessment, lack of attention to smoking cessation, variable adherence to management guidelines, delayed implementation of appropriate interventions, under-recognition of patients at higher risk of adverse outcomes, high hospitalisation rates for exacerbations and poor implementation of palliative care.

Real world data include information on heterogeneous cohorts of patients being cared for in local practice settings, with the local needs and resource availability that they have to deal with. At a system level it is important that guideline developers and policymakers take note of the problems with COPD care identified by real world data. The incorporation of real world evidence into guideline development and implementation has the potential to close the gap between knowledge of guidelines and application in practice. However, individual clinicians also need to improve their practice to address the deficiencies in care. It has been proposed that care could be improved by clinicians ensuring six basic points are followed:[16]

- All patients diagnosed with COPD have had spirometry that confirms the diagnosis at least once.
- Spirometry is performed to confirm or refute a diagnosis of COPD in all patients presenting with symptoms suggestive of COPD or recurrent chest infections.
- The frequency of both exacerbations and assessments of breathlessness is recorded for all patients with COPD and, if necessary, an appropriate change in management is made.
- Comorbidities are actively sought, diagnosed and managed.
- Patients are reviewed regularly to check pharmacological and non-pharmacological therapy follows guideline/ strategy document recommendations for individual patients taking into account the severity of symptoms and risk of exacerbations.
- Patients are reviewed promptly following an exacerbation to ensure that they are receiving appropriate therapy to reduce the risk of future events.

Quality improvement initiatives in COPD have focused on some of these points, particularly early identification of COPD, reducing hospital re-admissions for exacerbations, encouraging multi-disciplinary approaches to care, educational tools, self-management plans, and guideline adherence[85–88]. Programmes focused on integrated care and disease

management have shown that beneficial patient outcomes, including improvements in patient quality of life and hospitalisation rates for exacerbations can be achieved;[88–92] however, whether these can be sustained long-term has not been consistently demonstrated.[93] Targeted quality improvement initiatives can also make a difference, as was shown by the programme in Southampton concentrating on "revolving door" patients who had had multiple hospital admissions.[76] In low and middle income countries with limited resources the development of Standard Treatment Workflows (STWs) for the evaluation and management of COPD in primary and secondary healthcare settings may help overcome these errors.

There can be difficulties implementing and sustaining these programmes. A large-scale quality improvement programme in Alabama implementing an integrated care pathway (ICP) reduced hospitalisation rates significantly from 61% pre-ICP (standard care) to 39% during the ICP programme and reduced costs by over $11,000 per patient per year.[94] However, it was noted that its development and implementation "required commitment and considerable investment of time and human resources from all stakeholders" that did not feature in the economic analysis. Artificial intelligence and clinical decision support systems can help identify errors at an individual patient level, monitor guideline conformance and support clinical decision-making. These technologies are being used to support the COllaboratioN on QUality improvement initiative for achieving Excellence in STandards of COPD care (CONQUEST). This is a new, multi-national programme providing a roadmap to improved quality of COPD care based on four quality standards.[95,96] These relate to timely and appropriate diagnosis and assessment, appropriate and prompt non-pharmacological and pharmacological interventions, and regular and appropriate follow-up. Real world data collected for the CONQUEST programme has shown deficiencies in care of high-risk patients[16] and the effectiveness of a quality improvement programme designed to address these will be studied in a series of cluster-randomised trials referred to as the "PRagmatic EVAluation of a quality Improvement program for people Living with modifiable high-risk COPD" (PREVAIL) trials. These will compare patient outcomes including exacerbation rates, major adverse cardiovascular and respiratory event rates, and systemic corticosteroid usage between sites implementing the CONQUEST quality improvement programme and control sites continuing usual care.[96]

Albert Einstein famously said, "If I had an hour to solve a problem, I'd spend 55 minutes thinking about the problem and five minutes thinking about solutions". Real world data allow clinicians to think about the problems with how care is delivered in routine practice. Understanding that these problems exist and thinking about how and why they occur is fundamental to developing solutions to improve the diagnosis and management of patients with COPD.

Disclosure

The author reports no conflicts of interest in this work.

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