



BMJ Open Cost-consequence analysis of COPD treatment according to NICE and GOLD recommendations compared with current clinical practice in the UK

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ABSTRACT

Objectives The objective of this study was to model the clinical and economic impact of adapting current clinical practice in the management of patients with chronic obstructive pulmonary disease (COPD) to treatment according to national and international guideline recommendations.

Design Treatment mapping was undertaken to hypothetically redistribute patients from current clinical practice, representing actual prescribing patterns in the UK, to an alternative recommendation-based treatment scenario, representing prescribing in accordance with either National Institute for Health and Care Excellence (NICE) guidance [NG115] or Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2020 strategy.

Setting Primary care practices in the UK (1-year time horizon).

Participants Adults with COPD undergoing long-acting inhaler maintenance therapy in the UK (N=1 067,531).

Interventions Inhaler maintenance therapy.

Outcome measures Costs and clinical outcomes (type of treatment, rates of moderate and/or severe exacerbations, and mild-to-moderate and/or severe pneumonia events) were modelled for the two alternative pathways.

Results Compared with current clinical practice, treating patients according to NICE guidance resulted in an estimated annual reduction in expenditure of £46.9 million, and an estimated annual reduction in expenditure of over £43.7 million when patients were treated according to GOLD 2020 strategy. Total cost savings of up to 8% annually could be achieved by treatment of patients according to either of these recommendations. Cost savings arose from a reduction in the rates of pneumonia, with an associated decrease in costs associated with antibiotic use and hospitalisation. Savings were achieved overall despite a small increase in the rate of exacerbations due to the redistribution of certain patients currently undergoing triple inhaled therapy to therapies not containing inhaled corticosteroids.

Conclusion Redistribution of patients with COPD from current clinical practice to treatment according to published recommendations would provide substantial cost savings over the first year.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is known to affect around 1.2 million

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study provided a practical approach to estimate potential cost savings if guideline recommendations are implemented, using real-world evidence to compare costs for current clinical practice versus National Institute for Health and Care Excellence and Global Initiative for Chronic Obstructive Lung Disease guidelines.
- ⇒ The time horizon of the model was just 1 year, thus long-term savings were not assessed.
- ⇒ Individual patient preferences for specific inhaler treatments are not accounted for in the model.

people in the UK,¹ with a further 2.1 million living with undiagnosed COPD.² It is an incurable condition from which 28 600 patients die each year in the UK.³ Due to the chronic, progressive nature of the disease, COPD poses significant societal and economic burden. Within UK hospitals, the disease accounts for the use of more than 1 million bed-days each year.⁴ The National Health Service (NHS) spends more than £800 million each year in direct costs treating COPD^{2 5 6}; costs are nearly 10 times greater in patients with severe disease compared with mild disease.² It is estimated that a quarter of patients are prevented from working due to their condition²; COPD accounts for 24 million lost working days each year.^{2 5}

Pharmacological therapy is the cornerstone of COPD management and is used to reduce symptoms, reduce frequency and severity of exacerbations, and improve exercise tolerance and health status.⁷ The Global Initiative for Chronic Obstructive Lung Disease (GOLD) strategy recommends that each pharmacological treatment regimen should be individualised and guided by the severity of symptoms, risk of exacerbations, side effects, comorbidities, drug availability and

cost, and the patient's response, preference and ability to use various drug delivery devices.⁷

In addition to the GOLD strategy for the diagnosis, management and prevention of COPD,⁷ many countries in Europe have published national guidelines for the management of COPD⁸; for example, the National Institute for Health and Care Excellence (NICE) in the UK. Recent updates to NICE guidance [NG115] (updated in 2019)⁹ and GOLD strategy report (updated in 2020),⁷ incorporate new evidence within the evolving treatment paradigm for COPD. In addition to healthcare professionals, these guidelines are also referenced by healthcare payers, policy-makers and regulatory agencies.¹⁰ Payers use practice recommendations to make informed decisions on funding and reimbursement of specific therapies. Despite the significant utility of practice recommendations and the considerable resource investment into their development, their implementation is suboptimal.¹⁰ A multinational survey revealed that, despite a high awareness of COPD-practice recommendations among primary care physicians and respiratory specialists, there were gaps in their application in clinical practice.¹¹

Implementation of best practice is hampered by variations between recommendations as well as the complexity of inhaler prescribing (currently 112 different drug-device-dose inhalers are available to prescribe for COPD in the UK (as of March 2020)). NICE guidelines recommend progression to triple therapy in patients with persistent breathlessness and exacerbation despite other therapies⁹; GOLD strategy indicates triple therapy for GOLD D patients.⁷ However, triple therapy is over-prescribed in clinical practice and used in lower-risk patients who are not frequent exacerbators.^{12–15} In an analysis of patients with COPD from the Optimum Patient Care Research Database (387 primary care practices across the UK) from 2002 to 2010, triple therapy was prescribed after the initial diagnosis of COPD in 19%, 28%, 37% and 46% of GOLD A, B, C and D patients, respectively.¹² Among all patients receiving triple therapy, 25% were prescribed this within 1 year of diagnosis. Thus, real-life data indicate inappropriate prescribing of triple therapy and a drift towards overuse of triple therapy in patients who inappropriately commence treatment with inhaled corticosteroids (ICS) plus long-acting beta₂-agonists (LABA).¹² ICS can be withdrawn safely in both low-risk and high-risk patients, provided adequate bronchodilator therapy is in place; exacerbation rates are increased following ICS withdrawal only in patients with both raised eosinophils and a history of frequent exacerbations.^{16–18}

Optimisation of treatment according to NICE guidance [NG115]⁹ and recommendations from the GOLD 2020 strategy document⁷ represents an opportunity to meet the goal of appropriate prescribing of medicines as outlined in the NHS Long Term Plan for the treatment of people with respiratory disease.¹⁹ Additionally, there are likely to be financial and clinical implications of prescribing behaviour that deviate from treatment recommendations, representing potential cost savings

with recommendation-based treatment compared with current clinical practice.

In the current study, the clinical and cost implications of adapting current clinical practice in the management of patients with COPD to treatment according to published recommendations, are estimated through modelling based on real-world evidence.

METHODS

Population

The model includes adults with COPD undergoing inhaler maintenance therapy in the UK. This population was estimated using data for England on population estimates, COPD prevalence and the proportion of patients using inhalers.²⁰ Patients were allocated into four disease profiles, based on the GOLD 'ABCD' classification: (1) patients with low exacerbation history (0 or 1 moderate or severe exacerbations, not leading to hospitalisation) and current low symptoms (modified Medical Research Council (mMRC) 0–1 (dyspnoea); COPD Assessment Test (CAT)<10)); (2) patients with low exacerbation history and current high symptoms (mMRC≥2; CAT≥10); (3) patients with high exacerbation history (≥2 moderate exacerbations or ≥1 leading to hospitalisation) and current low symptoms; (4) patients with high exacerbation history and current high symptoms. It should be noted that in the GOLD strategy, the classification of patients is based on their disease profile at the point of COPD diagnosis; this does not apply to the hypothetical patient cohort used in this model. Disease profiles were derived from a COPD population-based study.²¹ This population-based study used data from the Clinical Practice Research Datalink,²² which collected information on treatment patterns for prevalent patients with COPD (with a coded diagnosis) across a network of primary care practices across the UK. Treatment patterns were reported on the number of patients on long-acting muscarinic antagonist (LAMA) or long-acting beta₂-agonists (LABA) (monotherapy), LAMA/LABA, LABA/ICS and LAMA/LABA/ICS (open-dose or fixed-dose combination) by GOLD A, B, C and D categories. Also, within each of these four disease profiles, the proportion of patients with high eosinophil levels (defined as a blood eosinophil count ≥300 cells/μL) were also reported. However, these data included patients with concomitant asthma. Data on treatment patterns and the proportion of patients with high eosinophil levels for patients without concomitant asthma were provided through personal communication with one of the authors of the population-based study.

Model structure

A cost-consequence model was developed in which current clinical practice, using real-world evidence on treatment patterns, is compared with a recommendation-based prescribing scenario, in a UK setting (England) from the perspective of the NHS, over a time horizon of 1 year.

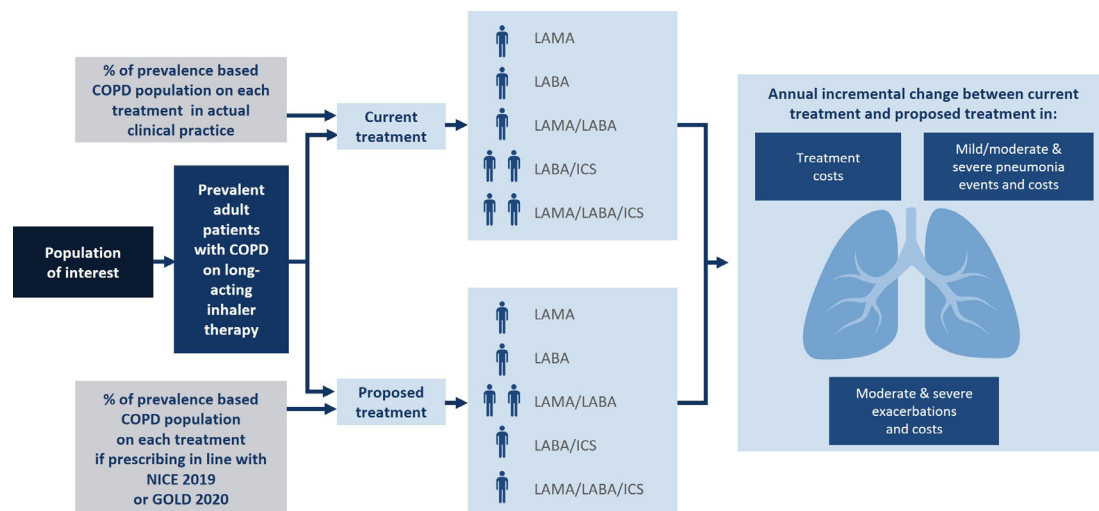


Figure 1 Model structure. Total annual costs and total annual events were modelled for the treatment of patients according to either of two alternative scenarios: treatment according to current clinical practice (current treatment) and treatment according to either NICE or GOLD recommendations (proposed treatment). Following treatment redistribution from current treatment to proposed treatment, fewer patients would be treated with LABA/ICS and LAMA/LABA/ICS whereas more patients would be treated with LAMA/LABA. COPD, chronic obstructive pulmonary disease; GOLD, Global Initiative for Chronic Obstructive Lung Disease; ICS, inhaled corticosteroids; LABA, long-acting β_2 agonist; LAMA, long-acting muscarinic antagonist; NICE, National Institute for Health and Care Excellence.

The model tracks a prevalent adult COPD population on inhaler therapy (in England) through two alternative treatment pathways: the current treatment pathway, which represents actual prescribing patterns; or, the proposed treatment pathway, which represents treatment optimisation with prescribing in accordance with either NICE guidance [NG115]⁹ or GOLD 2020 strategy⁷ (figure 1).

The cost and clinical outcomes of following these two alternative treatment pathways were estimated. Clinical implications included changes in the rate of moderate and severe exacerbations and mild-to-moderate and severe pneumonia episodes. Cost implications included resource use associated with treatment, exacerbations and pneumonia.

Data for model input parameters were collated from UK published sources (table 1). Costs are presented in 2018 Pound sterling. The model was built in Microsoft Excel Office 365 (Excel V.1904).

Treatment pathways

Current clinical practice

For each of the four disease profiles, the proportions of patients being treated with each therapy were derived from the updated population-based study. Treatments included: monotherapy with LAMA or LABA; dual therapy consisting of LAMA with LABA, or LABA with ICS, in fixed-dose combination or open-dose combination; triple therapy consisting of LAMA with LABA and ICS, in fixed-dose combination or open-dose combination.

Recommendation-based treatment

For the entire patient population categorised according to disease profile, treatment mapping was performed to redistribute patients from current treatment to the most

appropriate therapy according to treatment recommendations. Two mapping matrices were developed, one based on NICE guidance [NG115]⁹ (figure 2) and the other on the GOLD 2020 strategy⁷ (figure 3), as their recommendations differ for patients who are currently treated with ICS combinations. In addition to exacerbation history and severity of symptoms defined by the four disease profiles, the treatment mapping also considered treatment requirements for patients with high eosinophil counts. This aligns with the recommendations of both NICE and GOLD that suggest that patients with high eosinophil counts have a greater likelihood of benefit with a treatment regimen that includes ICS. The evidence also suggests that patients with low eosinophil counts have a reduced likelihood of benefit and therefore should not be exposed to the risk of adverse events.^{7,9}

Clinical parameters

Clinical implications of treating adult patients with COPD according to recommendations included changes in the rates of moderate and/or severe exacerbations and mild-to-moderate and/or severe pneumonia events.

Moderate exacerbations were defined as those that required treatment in the community with systemic corticosteroids and/or antibiotics following a visit to a general practitioner, accident and emergency department (A&E) or respiratory team. Severe exacerbations were defined as those that required treatment as a hospital inpatient, the majority of whom (70%) were assumed to have required an ambulance transfer to hospital.²³

To estimate the change in the rate of moderate or severe exacerbations, the following calculations were made. First, the baseline absolute risk of moderate or

Table 1 Clinical and cost model inputs

Parameter	Estimate		Source
Population			
COPD prevalence (% of population (N))	1.9 (1 067 531 patients)		NHS Digital ²⁰
Proportion of inhaler use (% of COPD population)	83		Gayle <i>et al</i> ²¹
Disease profiles*			
Proportion of patients with high or low prior exacerbations/high or low symptoms	Proportion of those with high eosinophil count (%)		
High/high	11.64	19.17	Gayle <i>et al</i> ²¹ (updated)
High/low	6.92	20.26	
Low/high	38.23	20.67	
Low/low	43.21	19.47	
Exacerbation rates (annual)			
Absolute risk with no prior exacerbations for LAMA/LABA (%)			
Moderate	7.13		Oba <i>et al</i> ²⁴
Severe	2.41		
Relative risk			
	No prior exaberations	Prior exacerbations	
LAMA	1.11	4.63	Oba <i>et al</i> , ²⁴ Cazzola <i>et al</i> , ²⁵ Hurst <i>et al</i> ²⁶
LABA	1.28	5.34	
LAMA/LABA	1.00	4.17	
LABA/ICS	1.15	4.79	
LAMA/LABA/ICS	0.87	3.62	
Pneumonia rates (annual)			
Absolute risk for LAMA/LABA (%)			
Mild-to-moderate	1.67		Singh <i>et al</i> ²⁸
Severe	3.08		
Relative risk for all therapies			
	Mild-to-moderate	Severe	
LAMA	1.00	1.00	Singh <i>et al</i> ²⁸
LABA	1.00	1.00	
LAMA/LABA	1.00	1.00	
LABA/ICS	1.31	1.70	
LAMA/LABA/ICS	1.31	1.70	
Costs (annual)†			
Drug costs (GBP)			
LAMA	347.38		NHS Prescription Services 2018 ³⁹
LABA	391.64		
LAMA/LABA	395.42		
LABA/ICS	351.85		
LAMA/LABA/ICS	541.42		
Exacerbations (GBP)			
Moderate	82.22		NHS Precription Services 2018 ³⁹
Severe	2158.00		
			NHS Improvement 2017–2018 ³¹
			Curtis <i>et al</i> 2018 ⁴⁰
			NICE 2018 ²³

Continued

Table 1 Continued

Parameter	Estimate	Source
Pneumonia events (GBP)		
Mild-to-moderate	130.73	NHS Improvement 2017–2018 ³¹
Severe	1997.94	Curtis 2018 ⁴⁰ NICE 2018 ²³

*Proportion of patients with high/low prior exacerbations and high/low symptoms (and proportion of those with high eosinophil count).
 †Weighted average of the number of items dispensed per year.
 COPD, chronic obstructive pulmonary disease; GBP, pound sterling; ICS, inhaled corticosteroid; LABA, long-acting β_2 agonist; LAMA, long-acting muscarinic antagonist; NHS, National Health Service; NICE, National Institute for Health and Care Excellence.

severe exacerbations in LAMA/LABA-treated patients with no prior exacerbations were estimated from events reported in the LABA/LAMA arms of a Cochrane meta-analyses (table 1).²⁴

Second, baseline exacerbation risk was then altered according to the relative risk of exacerbation for the other treatments compared with LAMA/LABA associated with no exacerbation history (table 1).^{24 25}

Finally, these relative risks were also used with a constant to generate the relative risks in patients with exacerbation history (table 1). This constant was calculated from the ORs and baseline risks reported in patients who had experienced one or more exacerbations following a year in which they did not experience exacerbation events.^{26 27}

The model assumed that mild-to-moderate pneumonia was treated with antibiotics prescribed by a general practitioner, whereas severe pneumonia required hospitalisation. The risk of mild-to-moderate or severe pneumonia events together with the relative risk between different drug classes with and without ICS were also applied to the model (table 1).²⁸

Cost parameters

Cost implications included resource use associated with treatment, and costs related to moderate and severe exacerbations and mild-to-moderate pneumonia events (table 1).

Annual treatment costs were estimated from prescription rates obtained from IQVIA NHS GP Practice Level Prescribing Data²⁹ and costs derived from the 2018 NHS drug tariff.³⁰ The cost per patient for each therapy class was calculated using a weighted average of the number of items (of each brand of product) dispensed per year. No adjustment was made to account for treatment adherence. It was assumed that patients dispensed LABA or LAMA were on that therapy alone and not both LABA and LAMA in combination.

The annual costs associated with moderate and severe exacerbations were estimated from resource use and treatment rates reported in NICE COPD economic model report,²³ undertaken in support of the COPD guideline review, together with costs from the NHS drug tariff (2018),³⁰ NHS reference costs (2017–2018)³¹ and the PSSRU unit costs of health and social care (2018).³²

The annual costs associated with mild-to-moderate pneumonia events were estimated using data on hospitalisation and outpatient antibiotic use reported in NICE guidance ‘Pneumonia in adults: diagnosis and management’ [CG191]³³ and NHS reference costs (2017–2018).³¹ For severe pneumonia events, the weighted average of all pneumonia costs in secondary care were estimated from NHS reference costs (2017–18).³¹

Base case analyses

In the base case analysis, it was assumed that all patients are hypothetically redistributed from current clinical practice to treatment according to either NICE or GOLD recommendations. Annual costs and outcomes were determined for the current treatment pathway and the proposed treatment pathway, enabling an estimation of the potential cost savings that can be achieved when treatment recommendations are followed. In addition, the overall and incremental costs of managing exacerbations and pneumonia events in the community, A&E or hospital setting were determined.

Scenario analyses

Scenario analyses were conducted to determine the effect of adherence to treatment recommendations. This involved modelling the impact on annual costs and cost savings when different proportions of patients (75, 50% and 25%) were hypothetically redistributed from the current treatment pathway to the proposed treatment pathway (either NICE or GOLD recommendations).

Sensitivity analyses

Sensitivity analyses were conducted in which the relative risks for exacerbations and pneumonia were varied according to the CIs of the data. This enabled estimation of how the total costs could vary based on the extremes of each of these outcomes.

Patient and public involvement

There was no direct involvement of patients or the public in this study.

RESULTS

Changes in treatment patterns for recommendation-based treatment compared with current clinical practice

Hypothetical redistribution of patients from treatment according to current clinical practice to treatment

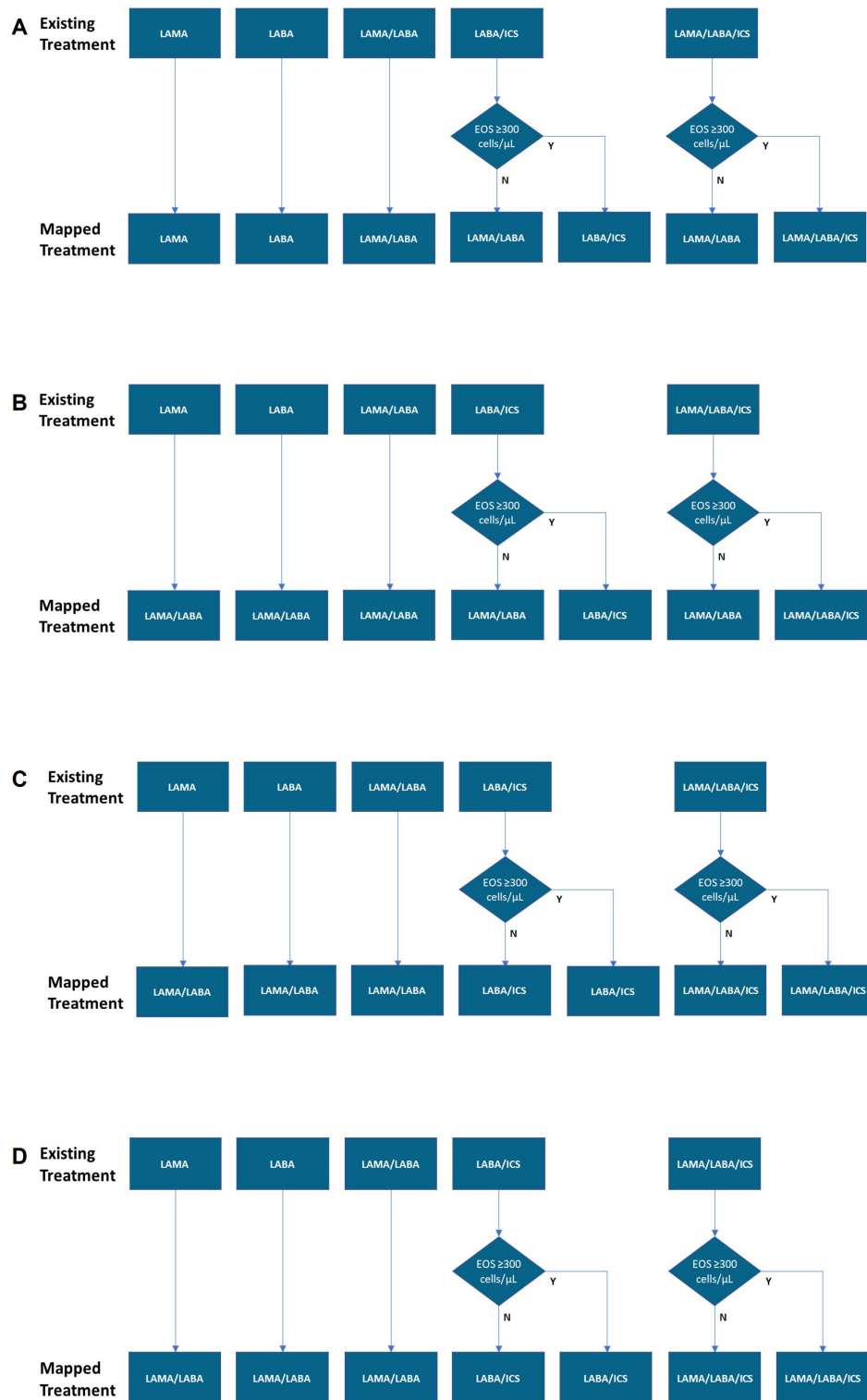


Figure 2 Treatment mapping according to NICE guidance [NG115]. NICE guidelines do not recommend LAMA and LABA individually, however, the model took a conservative approach assuming that some patients with low exacerbation and low symptoms might continue these therapies. The model used 300 cells/ μ L as a threshold for high EOS, but there is no specific number specified by NICE. (A) Patients with low exacerbation history and current low symptoms. (B) Patients with low exacerbation history and current high symptoms. (C) Patients with high exacerbation history and current low symptoms. (D) Patients with high exacerbation history and current high symptoms. The model includes a prevalent population of patients with COPD. A large proportion of patients will have a treatment history and therefore be on maintenance/follow-up therapy (not initial therapy). Therefore, when mapping, consideration was given to both initial treatment recommendations and follow-up treatment recommendations. COPD, chronic obstructive pulmonary disease; EOS, eosinophils; ICS, inhaled corticosteroids; LABA, long-acting β_2 agonist; LAMA, long-acting muscarinic antagonist; N, no; NG, NICE guideline; NICE, National Institute for Health and Care Excellence; Y, yes.

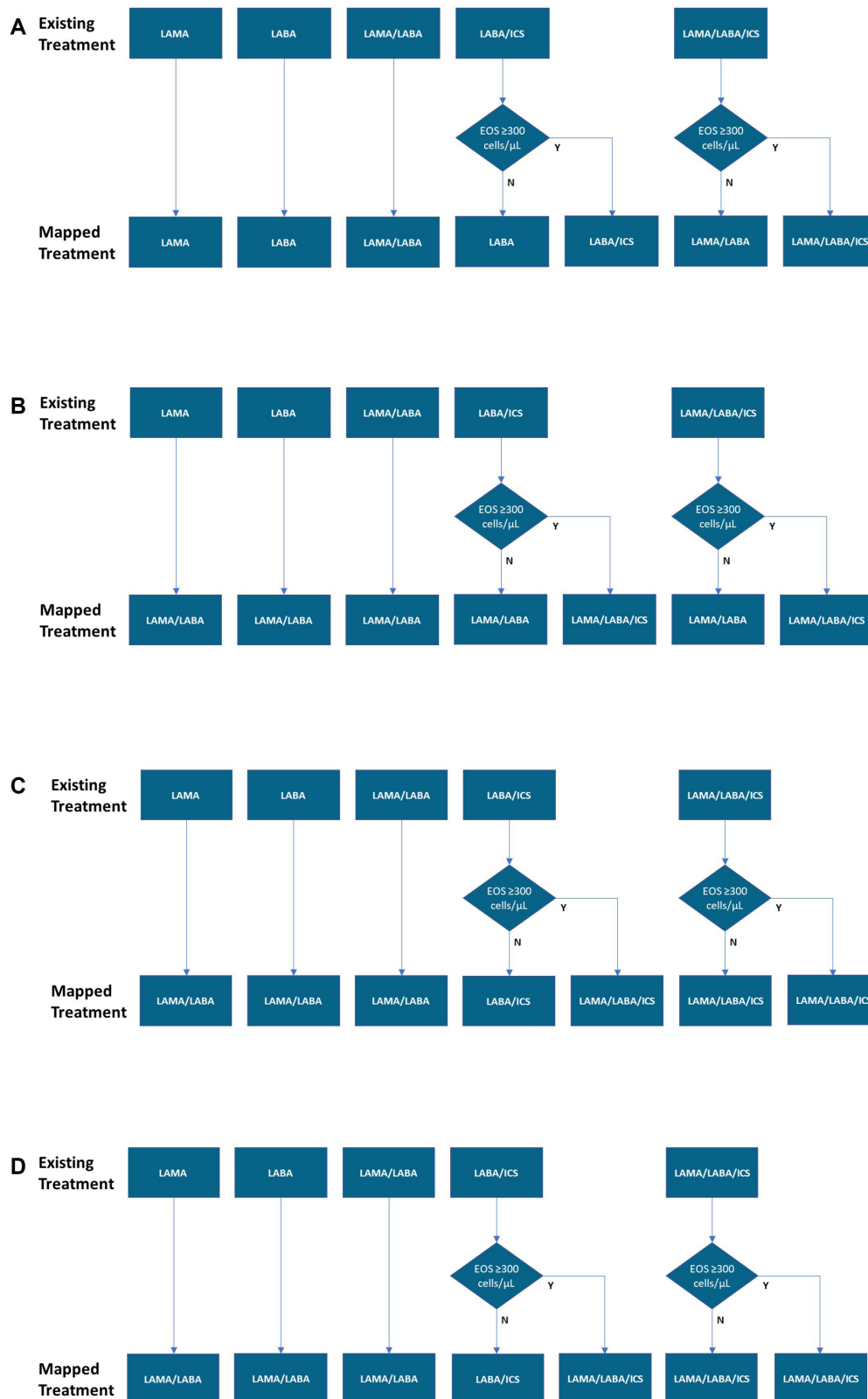


Figure 3 Treatment mapping according to GOLD 2020 strategy. (A) Patients with low exacerbation history and current low symptoms. (B) Patients with low exacerbation history and current high symptoms. (C) Patients with high exacerbation history and current low symptoms. (D) Patients with high exacerbation history and current high symptoms. The model includes a prevalent population of patients with COPD. A large proportion of patients will have a treatment history and therefore be on maintenance/follow-up therapy (not initial therapy). Therefore, when mapping, consideration was given to both initial treatment recommendations and follow-up treatment recommendations. COPD, chronic obstructive pulmonary disease; EOS, eosinophils; GOLD, Global Initiative for Chronic Obstructive Lung Disease; ICS, inhaled corticosteroids; LABA, long-acting β_2 agonist; LAMA, long-acting muscarinic antagonist; N, no; Y, yes.

Table 2 Differences in proportions of patients with COPD treated with each therapy and total costs according to current clinical practice, NICE guidance [NG115] and GOLD 2020 strategy

Therapy	High exacerbation history and current high symptoms	High exacerbation history and current low symptoms	Low exacerbation history and current high symptoms	Low exacerbation history and current low symptoms
Current clinical practice				
LAMA, %	0.47	0.60	4.26	8.97
LABA, %	0.02	0.09	0.39	0.93
LAMA/LABA, %	0.82	0.63	5.75	5.09
LABA/ICS, %	0.84	1.17	4.33	10.03
LAMA/LABA/ICS, %	9.48	4.43	23.51	18.18
Treatment according to NICE guidance [NG115]				
LAMA, %	0	0	0	8.97
LABA, %	0	0	0	0.93
LAMA/LABA, %	1.31	1.32	30.33	24.90
LABA/ICS, %	0.84	1.16	1.23	2.99
LAMA/LABA/ICS, %	9.48	4.43	6.67	5.42
Total savings vs current treatment	£46.9million (8%)			
Treatment according to GOLD 2020 strategy				
LAMA, %	0	0	0	8.97
LABA, %	0	0	0	7.97
LAMA/LABA, %	1.31	1.32	30.33	17.85
LABA/ICS, %	0.66	0.87	0	2.99
LAMA/LABA/ICS, %	9.66	4.72	7.90	5.42
Total savings vs current treatment	£43.7million (8%)			

COPD, chronic obstructive pulmonary disease; GOLD, Global Initiative for Chronic Obstructive Lung Disease; ICS, inhaled corticosteroid; LABA, long-acting β_2 agonist; LAMA, long-acting muscarinic antagonist; NICE, National Institute for Health and Care Excellence.

according to NICE or GOLD recommendations led to reductions in ICS-containing dual or triple therapy among those who have a low exacerbation history. Overall, 72.0% of patients with COPD undergoing inhaler therapy were being treated with ICS-containing regimens under current clinical practice, but the proportion reduced to 32.2% overall following treatment redistribution in accordance with NICE or GOLD recommendations.

For all four disease profiles, there was an increase in LAMA/LABA dual therapy following treatment redistribution, with the highest increases among those with a low exacerbation history. Whereas only 12.3% of patients overall were treated with LAMA/LABA in clinical practice, the proportions increased to 57.9% and 50.8% following treatment redistribution according to NICE or GOLD recommendations, respectively.

Changes in costs and outcomes if patients are treated according to NICE guidance [NG115]

In the base case analysis (using the population of England), treating all patients according to NICE guidance [NG115] resulted in an estimated annual reduction in expenditure of £46.9million, giving total savings of 8%

of the cost of current practice (table 2). This included an 8% reduction in treatment costs, saving £32million. Considerable savings arose from a reduction in treatment costs due to pneumonia: £241 560 (savings of 10% of the cost of pneumonia treatment) for mild-to-moderate pneumonia and £15 127 961 (savings of 18%) for severe pneumonia. There was a slight increase in costs associated with exacerbations; 1% increase for both moderate (£58 504) and severe (£518 128) exacerbations. This was primarily due to withdrawal of ICS in patients categorised as low-risk or having low eosinophil levels that is, patients on LAMA/LABA/ICS triple therapy being redistributed to LAMA/LABA dual therapy. However, in patients redistributing from LABA/ICS dual therapy to LAMA/LABA, there was a reduction in the rate of exacerbations.

Changes in costs and outcomes if patients are treated according to GOLD 2020 strategy

In the base case analysis (using the population of England), treating all patients according to the GOLD 2020 strategy, compared with current practice, resulted in an annual overall reduction in costs of just over £43.7million, giving total savings of 8% (table 2). The

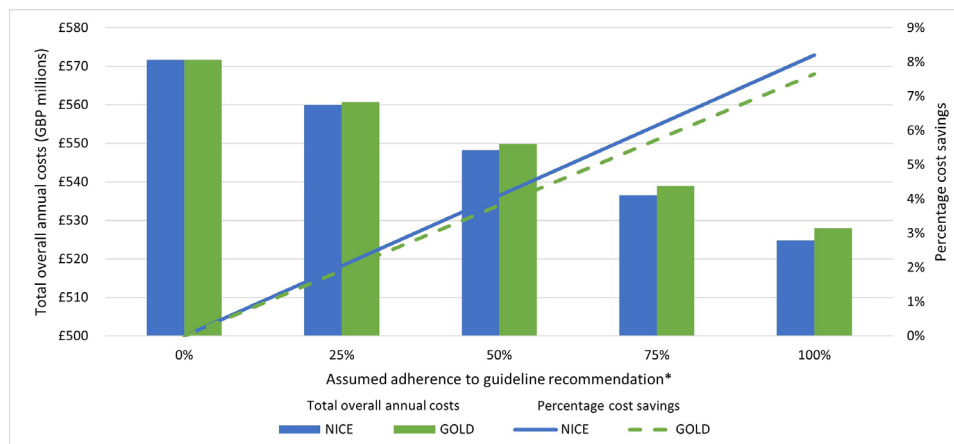


Figure 4 Total overall annual costs (primary axis, bars) and savings (secondary axis, lines) achieved at different levels of guideline adherence. *Assuming only a proportion of the number of patients is treated according to guideline recommendations. This percentage was applied across the entire population. Including equal proportions in each patients groups. GBP, Pound sterling; GOLD, Global Initiative for Chronic Obstructive Lung Disease; NICE, National Institute for Health and Care Excellence.

majority of this was due to a reduction in the costs associated with pneumonia: reduction of £241 560 (savings of 10%) for mild-to-moderate pneumonia and £15 127 961 (savings of 18%) for severe pneumonia. There was a small increase (around 1%) in the annual number of moderate and severe exacerbations, leading to a minor increase in costs associated with exacerbations; 1% increase for both moderate (£114 263) and severe (£1 011 938) exacerbations. As with NICE recommendations earlier, this was primarily due to withdrawal of ICS in patients categorised as low-risk or having low eosinophil levels that is, patients on LAMA/LABA/ICS triple therapy redistributing to LAMA/LABA dual therapy. Patients redistributing from LABA/ICS dual therapy to LAMA/LABA showed a reduction in the rate of exacerbations.

Scenario analyses

Varying the modelling analysis according to the extent of adherence to recommendations had a proportionate effect on the percentage cost savings (figure 4, online supplemental table S1). Although the specific figures for the annual cost outcomes varied slightly between NICE and GOLD recommendations, the overall savings were the same at each level of adherence.

Sensitivity analysis

Varying the relative risks for moderate and severe exacerbations to the upper or lower values of the CI led to no difference in the savings on annual costs compared with the base case, when NICE guidance [NG115] was followed. When the GOLD 2020 strategy was followed, varying the relative risk for moderate and severe exacerbations to the upper value of the CI led to no change in the annual savings; at the lower value of the CI, the savings in annual costs were reduced by 1% compared with the base case.

Varying the relative risks for pneumonia to the lower value of the CI led to 1% decrease in the annual cost

savings for treatment according to either NICE or GOLD recommendations, whereas varying the relative risk to the upper value of the CI led to 1% increase in the annual costs savings for treatment according to either NICE or GOLD recommendations.

DISCUSSION

This study modelled the clinical and economic impact of adapting current clinical practice in the management of patients with COPD, profiled based on their severity of symptoms and history of exacerbations, to treatment according to published recommendations. Due to the high proportion of patients inappropriately prescribed ICS in current practice, the model estimates that treatment redistribution according to either NICE or GOLD recommendations would lead to a lower proportion of patients with COPD who are prescribed ICS-containing regimens. Appropriate use of ICS in patients with COPD can be beneficial; reducing exacerbations and improving symptoms in those who have frequent exacerbations, raised blood eosinophil counts or a history of asthma or asthma–COPD overlap.³⁴ However, chronic use of ICS is associated with a significant risk of developing pneumonia.³⁵ Recommendation-based prescribing also led to increased use of LAMA/LABA, with more than half of patients using LAMA/LABA in line with both NICE guidance [NG115]²³ and GOLD 2020 strategy⁷ suggesting this combination for the majority of patients with COPD.

In terms of economic outcomes, the results indicate that treating patients according to NICE guidance [NG115]²³ or GOLD 2020 strategy,⁷ compared with current clinical practice, would provide cost savings. Savings were largely attributed to decreased rates of pneumonia, with associated reductions in costs arising from antibiotic use and hospitalisation. Despite a small increase in exacerbations, overall the results suggest that treatment according to



guideline recommendations would provide clinical and cost benefits. Cost savings that could be achieved were comparable when either NICE guidance [NG115]²³ or GOLD 2020 strategy⁷ were applied. Sensitivity analyses showed that the results were In the base case analysis, the estimated savings are based on 100% adherence to recommendations with complete switchover of patients to recommended treatment, which is unlikely to be attained in practice. The scenario analyses showed that savings could be achieved even at lower levels of adherence to NICE or GOLD recommendations, but with cost savings increasing in line with the proportion of patients redistributing from current clinical practice to recommendation-based treatment.

NICE guidance and GOLD strategy report are regularly updated to incorporate recently available evidence. Treatment according to evidence-based recommendations can improve the quality of healthcare and reduce variations in the treatment and management of COPD,¹⁰ and as demonstrated by this study, can provide cost savings by reducing unnecessary treatment. However, recent updates to these documents as well as variations in recommendations have hampered their uptake in clinical practice.

The economic model described in this study is based on real-world evidence and local payers may find this model useful for understanding the financial and patient benefits of optimising COPD treatment according to NICE guidance [NG115]²³ or GOLD 2020 strategy.⁷

A number of limitations in the current economic analysis should be noted. First, the time horizon of the model was just 1 year, thus long-term savings were not assessed. Second, the estimate for the increase in risk of pneumonia events from use of ICS-based regimens was based on a meta-analysis that was conducted prior to some of the larger randomised controlled trials reporting (eg, IMPACT³⁶). However, the magnitude of this increased risk is consistent with more recent meta-analyses.^{37,38} In addition, we applied the same excess pneumonia risk across all ICS users. Recent evidence suggests that this may vary according to a number of factors, including type of ICS and severity of COPD.³⁷ For example, the risk of ICS-related pneumonia in patients with less severe COPD is lower than the risk for patients with very severe COPD. The model may therefore over-estimate the reduction of pneumonia events in the proposed treatment scenario. Third, this study does not include other potential clinical implications of ICS use, for example, type 2 diabetes and osteoporosis; however, the GOLD 2022 strategy states that such associations are not definitive, due to lack of good-quality evidence.⁷ If these additional potential adverse outcomes were added to the model this would increase the cost savings of treating according to clinical guidelines. Fourth, treatment costs were calculated using prescription data on the individual therapies and fixed-dose combination therapies. Prescriptions for individual therapies were assumed as being for monotherapy use only, as the data did not allow for identification of open-dose combination use. Hence, separate prescriptions for

LAMA and LABA were considered as being for use of that agent alone, whereas in reality, some of these prescriptions may have been for use of LAMA and LABA in combination. However, the numbers of such prescriptions are likely to be very few.

Finally, this model is a comparison of two alternative scenarios: current treatment and treatment according to clinical recommendations. The results of this study should not be interpreted to mean that a blanket switch of patients is appropriate. Any proposed change to treatment should be discussed with the patient, and should include a review of the diagnosis, management of comorbidities, symptoms and exacerbation history, inhaler technique, adherence to medication and adverse outcomes associated with treatment choices.

CONCLUSIONS

In addition to clinical benefits, cost savings (over at least 1 year) can be achieved through treatment of patients with COPD according to NICE guidance [NG115]²³ or GOLD 2020 strategy,⁷ compared with current clinical practice in the UK. Therefore, optimising treatment in line with evidence-based recommendations could reduce the financial burden of COPD management on the healthcare system.

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