Comprehensive Respiratory Assessment in Advanced COPD

A "campus to clinic" Translational Framework

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Introduction

COPD is a clinical syndrome representing a spectrum of lung pathologies associated with systemic co-morbidities and exacerbations, which contribute substantial morbidity and mortality. The "umbrella" nature of the syndrome has resulted in the detailed investigation and description of multiple disease phenotypes relating to the heterogeneity of lung pathophysiology but also to other clinical features such as symptom burden, exacerbations, comorbidities, nutritional status and respiratory failure(1-5). Phenotype specific therapies already exist, for example lung volume reduction therapies, nutritional support and home non-invasive ventilation. Moreover, this may extend to other features such as increased cardiovascular risk and inflammometry-directed exacerbation management(6;7).

These advances provide an opportunity to make a significant change in the care of patients with COPD both by personalising the management of patient symptoms and future health risk (as embodied in the updated GOLD staging schema(8)) and by the proactive identification and treatment of systemic comorbidities which are known to impact on health outcomes. For these scientific developments to translate to patient care, a more detailed, systematic framework for clinical assessment is needed in routine clinical practice. Such an approach is also required to stratify care across the range of disease severity/complexity so that care can be individualised and services organised accordingly. In keeping with this, the UK NHS National Outcomes Strategy for COPD recommends that the assessment of disease severity should be based on a "comprehensive assessment" of clinical characteristics and that services should be integrated to ensure specialist care focuses on more "complex or unstable" disease(9). Currently however, in the UK and many other healthcare systems, proactive identification and management of complex medical, psychological and social care needs in COPD occurs infrequently and is poorly coordinated(10). By contrast, a structured, approach to managing the multiple care needs of elderly people through a "Comprehensive Geriatric Assessment" has been shown to be effective in improving health outcomes and reducing healthcare utilisation(11) and is now in widespread use.

In this paper we propose a framework for a structured, systematic and detailed assessment in COPD which we have termed the "Comprehensive Respiratory Assessment (CRA)". We describe the development and implementation of this tool within a specialist-led COPD service that stratifies patients for advanced/complex

disease. We demonstrate the feasibility by presenting data from the CRA over the first 18 months of its use and discuss the potential value of this approach. We propose how a structured assessment with an annualised review could be integrated into commissioned COPD disease management programmes to support shared patient decision making and self-care, and the establishment and sharing of agreed management plans for scheduled and unscheduled care.

Development of the Comprehensive Respiratory Assessment

The complex COPD service at Glenfield Hospital was established in 2013 with the aim of ensuring thorough and consistent assessment and treatment of patients with complex, advanced COPD in the Leicestershire area (serving approximately one million people). The initiative is supported by the Leicester NIHR Respiratory Biomedical Research Unit which contributes to data collection through anIT data management platform serving also as an electronic clinical patient record. A bespoke database solution with web based interface was developed to capture relevant and highly structured data contemporaneously (see online supplement and Supplement figs 1 to 3) and facilitate population of letter templates.

Accepted, specific criteria for "advanced" or "complex" COPD do not exist and our pragmatic stratification approach (Box 1) identifies patients with a high symptom burden, high future health risk and potential need for specialist services such as lung volume reduction therapies or home ventilation. Patients accepted to the service provide informed consent for their clinical data to be used for research purposes.

Box 1: Referral Criteria for Advanced COPD Service

FEV_1 < 50% predicted plus one of the following:

- 2 or more admissions to hospital for acute exacerbation of COPD (AECOPD)
- Severe disability (MRC score 4 or worse)
- Continued smoking
- Low BMI (<21kg/m^2) or unexplained weight loss (>5% in 6 months)
- Candidacy for Lung Volume Reduction Therapies
- Established Respiratory Failure (PO_2 < 8 in stable state)

The CRA is structured to address key clinical problems that patients present to clinicians (rather than specific pathophysiologies) and is conducted in a setting where

shared decision making can be undertaken, support for patient self management provided and the outcome of the review shared with other clinical and social care teams who manage the patient. The assessment is conducted annually because the nature of the condition (with variable rates of decline, onset of comorbid conditions, exacerbation frequency and uncertain prognosis) requires a system of regular review to be built into the process.

The CRA is mapped to address patient centred clinical problems that affect current symptom burden and future health risk; limitations to physical activity and mobility due to breathlessness (Exercise/symptom Domain), repeated exacerbations and respiratory infection (Exacerbation Domain), the development of extra-pulmonary complications and co-morbidities (Co-morbidity Domain) and concerns about shortened life expectancy and end of life care (Prognostic Indicator Domain). The content of the CRA in each domain and example treatment outcomes are shown in Box 2.

Box 2. The Domains and Content of the Comprehensive Respiratory Assessment

	Assessment	**Diagnostic**	**Outcome**
Exercise/ Symptom Domain	• MRC scale • Drug therapy • Attendance at PR • CAT score	• Lung function • Hyperinflation • Exercise desaturation • Exercise testing • Muscle strength	• Prescription eg Bronchodilator • Referral for PR • Consider LVR • Ambulatory oxygen
Exacerbation Domain	• Exacerbation Frequency • Hospital admission • Vaccination history • Drug Therapy	• Sputum microbiology • Blood eosinophilia • CT imaging	• Exacerbation management strategy • Prescription eg ICS/mucolytic • Antibiotic prophylaxis • Vaccination
Co-morbidity Domain	• Medical History • Weight loss • History of anxiety or depression • Fracture history	• BMI • Bone mineral density (DEXA) • Vitamin D • FFMI and SMI (DEXA) • ECG/BNP • Framingham Risk score • Serum testosterone • HADS	• Osteoporosis secondary prevention • CV risk reduction • Nutritional therapy • Hormone replacement • Psychological therapies
Prognostic Indicator Domain	• Smoking status • Home oxygen use • NIV use (acute and home) • Oedema • “Surprise” question	• Blood Gases • iBODE	• Smoking cessation • Home oxygen or ventilation • EoL/advance care planning • Palliative care referral

Notes: PR = Pulmonary rehabilitation; LVR = Lung Volume Reduction therapy; ICS = Inhaled Corticosteroid; DEXA = Dual Emission X-ray Absorptiometry; FFMI = Fat Free Mass Index; SMI = Skeletal Muscle Index; HADS = Hospital Anxiety and Depression Score; NIV = Non-invasive Ventilation; "Surprise" question = "would you be surprised if your patient died in the next year"; iBODE see ref(12); EoL = End of Life; CV = cardiovascular, BNP = Brain Natriuretic Peptide, ECG = electrocardiogram.

The CRA is conducted as part of a structured annual review. The assessment is performed before the clinic consultation by a specialist respiratory nurse and subsequently discussed with the patient during the physician consultation where a detailed management plan is agreed. The CRA and agreed care plan are recorded in the patient's casefile and discussed with community teams who share responsibility for patient care. The annual review provides the opportunity to involve the multi-professional team (for example, dietetics, palliative care, pulmonary rehabilitation, psychology, smoking cessation and community support) and to provide supported self-management for the patient (see Fig. 1).

The results of the CRA in the first 121 patients (52% males, mean (SD) age: 65 (9) years, FEV_1: 32 (15) % predicted) enrolled over the first 18 months are shown in Table 1.

Discussion

The CRA provides a mechanism for systematically encompassing the complexity of COPD and its systemic manifestations in clinical practice and ensuring important features and comorbidities (and their treatment) are not missed or forgotten. The embedding of the CRA in an annual review process provides a platform for shared decision-making with the patient and a resultant care plan that sets out treatment priorities, identifies suitability for tailored interventions (eg LVR or ventilatory support) and ensures the multi-professional team are engaged where required. We believe that such a structured approach (which is not in place in most healthcare settings) is a crucial next step for "campus to clinic" translation of recent and future scientific advances in COPD phenotyping and personalised care.

The data we present from the implementation of the CRA in our complex COPD service demonstrates both feasibility in this setting and the significant symptom burden and high prevalence of extra-pulmonary co-morbidities amongst our cohort. Examples of the latter include a notably high exacerbation frequency, substantial cardiovascular risk and high rates of reduced bone mineral density and nutritional

depletion. The comprehensive nature of the assessment ensures that patients who may benefit from phenotype specific therapies are routinely and systematically identified. For example, the prevalence of significant hyper-inflation was high suggesting that lung volume reduction therapies (which are rapidly evolving through the development of bronchoscopic techniques(13)) may be suitable for a higher proportion of this population than is currently offered. Similarly, it is accepted that access to key members of the multi-professional team (for example pulmonary rehabilitation, dietetics, palliative care) improves clinical outcomes but these needs often go unrecognised in routine primary and secondary care practice and referral rates are highly variable. The CRA provides the necessary clinical and diagnostic information together with management prompts to ensure these therapeutic opportunities are considered. The assessment also offers the potential to personalise exacerbation management; for example, a third of patients had a blood eosinophilia and a third had positive sputum bacteriology suggesting that individualised exacerbation self-management strategies could result in improved outcomes and reduced harm and healthcare costs (3).

The updated GOLD staging system incorporating symptom burden, exacerbation frequency and lung function impairment(8) is the first step towards a more sophisticated clinical assessment of COPD but has prompted questions about its applicability in clinical practice. Others have suggested categorisation in terms of "severity, activity and impact"(14;15) or "best current control vs future risk"(16). We extended these concepts by developing a framework with sufficient detail that can be implemented "in the field". We have structured the CRA around four key clinical problems encountered in routine practice to ensure the clinic consultation remains "patient centred" whilst ensuring phenotype specific therapies can be appropriately offered. However, we do not intend to be prescriptive about the specific components of the CRA and recognise that some of the assessments/diagnostics proposed could justifiably be included in more than one domain (for example frequent exacerbation or hospitalisation is an indicator or poor prognosis(17).

Our initial data demonstrate an unmet need for pro-actively addressing complexity and multi-morbidity in COPD and evidence from other models of care (for example the comprehensive geriatric assessment) suggests that improved health outcomes do follow (11). We propose that the CRA and annual review needs to result in a care plan, which is agreed with the patient and includes components of scheduled and

unscheduled care. It is desirable that the process incorporates support for self-management to ensure the patient understands the care plan and is able to actively participate in its delivery (See Fig 1). However, unless the process is incorporated in a coordinated disease management programme where the care plan can be executed, improvements in the quality and outcome of care may not be realised.

We have developed the CRA in the setting of a specialist led complex COPD service, which requires the establishment of referral (or stratification) criteria. Should this be applied across the whole COPD population or solely to those with advanced or complex disease (however that might be defined)? Our proposed CRA is likely to be most profitable in those with more complex disease where symptom burden and future risk is highest, risk of comorbidities greatest and the need for specialised intervention more likely but we believe the principles are applicable to all patients whether managed by primary care or specialist physicians with the content modified according to the burden of disease and the healthcare setting. We suggest that scheduled annual reviews should be provided for all patients, and indeed in the UK this is mandated in the NHS contract for primary care providers.

In the UK it is notable that health policy is increasingly focused on containing healthcare costs by moving care of long term conditions away from hospitals into community settings. This is at odds with the above mentioned developments in disease phenotyping and personalised care in COPD because there may be inadequate expertise or diagnostic infrastructure in community settings to allow these developments to be implemented. We suggest that this dilemma can only be solved by commissioning whole disease management pathways which includes the provision of specialist assessment where individual patient needs are complex. This is in line with newer integrated commissioning models for patients with long term conditions (for example capitated budget approaches such as "Year of Care" (www.nhsiq.nhs.uk/ltcyoc)) and also with the recently published NHS "Five Year Forward View" (www.england.nhs.uk/2014/08/15/5yfv/). Moreover, expert, comprehensive assessment in those with complex/advanced disease may reduce healthcare costs for example by implementing cutting edge individualised exacerbation management strategies and tailored end of life care.

In summary, we have developed a structured comprehensive assessment for patients with COPD, which we have embedded in an annual review process as part of a

complex COPD service. We believe that the principles underpinning this approach (disease stratification structured assessment, annual review and shared decision making,) are fundamental in the planning and commissioning of whole disease management pathways. Structuring care in this way is the only way to ensure that scientific developments in disease phenotyping and personalised care are translated into clinical practice in a cost effective manner.

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Figure Legend

Figure 1. Proposed Components and Organisation of a Structured Annual Review for patients with complex COPD

Exercise/Symptom Domain	
RL/TLV (%)	64 (11)
RV (% predicted)	213 (27)
Hyperinflation [a]	59%
TLCO (% predicted)	38
ISWT (m)	140
QMVC (% predicted)	45 (24)
MRC dyspnoea score	4 (IQR 4-4)
Previous PR attendance	71%
Exercise desaturation [b]	51%
CAT score	25.5 (6.3)

Exacerbation Domain	
COPD related admissions	0.9 (1.4)
Antibiotics courses	5.1 (4.4)
Oral steroid courses	5.0 (4.4)
Blood eosinophilia [c]	33%
Sputum culture positive	38%
Flu vaccination	94%
Pneumonia vaccine	84%
Maintenance oral steroids	11%
Maintenance antibiotics	21%

Co-morbidity Domain	
Other co-morbidity	76%
Abnormal BNP [d]	22%
Framingham Risk Score	
Low (<10%)	46%
Intermediate (11-20%)	36%
High (>20)	18%
Sarcopenia [e]	64%
Osteoporosis [f]	14%
BMI (kg/m^2)	25.3 (7.4)
BMI ≥ 30 kg/m^2	25%
HADS anxiety > 10 [g]	33%
HADS depression > 10 [g]	27%

Prognostic Indicator Domain	
Pack years (years)	39 (16)
Current Smokers	25%
Long term oxygen therapy	35%
"Surprise" Question (% No)	23%
BMI < 21 kg/m^2	32%
Nutritional depletion [h]	53%
iBODE [j]	7.3 (1.1)

Table 1. Results from the Comprehensive Respiratory Assessment over the first 18 months.

Figures for events refer to the preceding 12 months. Bone mineral and lean mass measured from DEXA. Lung volume measurements measured using body plethysmography (n = 71). [a] Residual volume >150% predicted and RV/TLC > 55% (calculated as proportion of total population of 121 subjects); [b] ≥ 4% desaturation on exertion; [c] blood eosinophil count > 0.4 x10^9; [d] > 95% upper limit of confidence interval; [e] Skeletal muscle index (SMI) calculated as the height normalised sum of appendicular lean mass. Sarcopenia defined as SMI <7.23 (male) or <5.67 (female)(5); [f] T score ≤ -2.5; [g] HADS anxiety or depression scores > 10; [h] Nutritional depletion: FFMI <15kg/m^2 (females)/<17kg/m^2 (males) or BMI < 21kg/m^2(5). [j] Mean (SD) iBODE score see ref(12).