Predictors of accuracy of diagnosis of chronic obstructive pulmonary disease in general practice

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ABSTRACT

Objectives: To compare the clinical diagnosis of chronic obstructive pulmonary disease (COPD) with results of post-bronchodilator spirometry in general practice, and examine practitioner, practice and patient characteristics associated with agreement between clinical and spirometric diagnoses.

Design, setting and participants: General practitioners from practices in Sydney identified eligible patients aged 40–80 years seen in the past year and prescribed respiratory medications whom they regarded as having COPD. Between November 2006 and April 2008, we collected information on the GPs and their practices, and demographic information, smoking status, comorbidities, respiratory medicines use, vaccination status, quality of life and spirometry results for participating patients.

Main outcome measures: Frequency of COPD diagnosis on spirometry; odds ratios for characteristics associated with agreement between clinical and spirometric diagnoses.

Results: 56 GPs from 44 practices participated in the study. Of 1144 eligible patients, 445 were recruited (mean age, 65 years; 49% male). Of these, 257 (57.8%) had post-bronchodilator spirometry consistent with COPD ± asthma, 16 (3.6%) had asthma only, 82 (18.4%) had normal spirometry, and 90 (20.2%) had other spirometric diagnoses. Having a spirometer in the practice was not predictive of agreement between clinical and spirometric diagnoses. Older patient age was significantly associated with correct diagnosis, while higher numbers of comorbidities were associated with misdiagnosis.

Conclusions: A substantial proportion of patients clinically identified as having COPD in general practice do not have the condition according to spirometric criteria, with inaccurate diagnosis more common in patients with comorbidities. Policy and practice change is needed to support the use of spirometry in primary care.

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Chronic obstructive pulmonary disease (COPD) is a major cause of mortality, morbidity and health service use, including hospitalisation. It is the seventh leading cause of burden of disease in the Australian population and the fourth and sixth leading causes of death for men and women, respectively.[1] The prevalence of COPD in the population attending general practitioners in Australia is estimated to be 2.6%.[2] In patients aged 65 years or older, COPD is managed at a rate of 21 per 100 encounters with patients in this age group,[3] making it a common problem in older people.

Both international[4] and Australian[5] clinical practice guidelines for COPD state that its diagnosis rests on the demonstration of airflow obstruction that is not fully reversible. Spirometry is therefore essential for accurate diagnosis of COPD. Although there is evidence that office spirometry improves early detection of COPD in general practice, and despite the majority of general practices in Australia owning a spirometer,[6] it is infrequently used in primary care in Australia and internationally, and the diagnosis is usually made on clinical grounds.[7-9] Several studies in primary care settings have demonstrated inaccuracy of COPD clinical diagnosis compared with spirometric diagnosis.[10-13]

We know little about the practitioner, practice and patient factors that influence the accuracy of the diagnosis of COPD in general practice in Australia or comparable countries. Understanding these factors could be of use in developing and targeting interventions aimed at improving COPD diagnosis. As part of the baseline assessment for an intervention study involving patients considered by their GPs to have COPD, we examined the accuracy of the GPs' diagnoses in relation to the gold standard of spirometric diagnosis. We also examined practitioner, practice and patient factors that predicted agreement between the diagnostic label and the finding of post-bronchodilator airflow obstruction.

METHODS

This study was done in the context of a randomised controlled trial of a nurse-based intervention to improve COPD management. The data are from the cross-sectional baseline assessment conducted for this trial between November 2006 and April 2008. Ethics approval was granted by the University of New South Wales Human Research Ethics Committee.

Study population and data collection

The protocol of the trial has been published elsewhere.[14] In brief, GPs were recruited from a list of 256 GPs from practices in south-western Sydney who had previously taken part in research or who attended continuing medical education events held by local Divisions of General Practice. GPs on the list were approached by mail, followed by a telephone call from one of the investigators (NAZ or SV). If GPs expressed interest, a member of the project team (NAZ, SV or OH) visited the practice to explain the study and gain informed consent from the GP(s) involved. At this visit, GPs were asked to complete a questionnaire that covered characteristics of themselves and their practices. The practitioner characteristics were age, sex, vocational registration status, local or overseas graduate, and years in practice. Practice characteristics collected were practice accreditation status, presence of a spirometer in the practice, presence of a practice nurse, presence of a practice manager, and whether it was a solo or a group practice.

Participating GPs were asked to search their electronic prescription records to identify patients who had been prescribed medications used for COPD, defined as inhaled β_2 agonists, inhaled corticosteroids, ipratropium bromide, tiotropium, oral theophylline and oral corticosteroids. Patients were eligible if they were aged between 40 and 80 years, had been prescribed one or more of these medications, and had seen the GP in the previous 12 months. GPs were asked to manually review the list generated and iden-

tify those patients they considered to have a diagnosis of COPD, emphysema or chronic bronchitis, including those they considered to have coexisting problems, such as asthma. GPs were asked to include all eligible patients regardless of how or where the diagnosis had been made; information on how the diagnosis was made was not collected. GPs were asked to exclude patients if they considered they did not speak English or had significant cognitive impairment.

The project officers (O H and I H) recruited the identified subjects, with consent, into the trial and gathered data during a home visit. Patient characteristics recorded were age, sex, number of comorbidities, whether born in Australia or overseas, respiratory medicines used, vaccination status, quality of life (assessed using the St George's Respiratory Questionnaire and the 12-item Short Form Health Survey), and smoking status.

Spirometry procedure

The patient assessment included pre- and post-bronchodilator spirometry using an EasyOne spirometer (ndd Medical Technologies, Andover, Mass, USA), performed by one of two project officers from medical backgrounds (O H and I H) who had been trained in spirometry at the respiratory function laboratory at Liverpool Hospital in Sydney. Patients were instructed not to take short-acting β_2 agonists for at least 4 hours before the test, or long-acting β_2 agonists, ipratropium bromide or tiotropium for at least 12 hours before the test. Post-bronchodilator spirometry was performed between 10 and 15 minutes after 400 μg of salbutamol was delivered via a metered dose inhaler. Three forced expirations were attempted before and after bronchodilator administration, and the spirometer's firmware algorithm was used to select best forced expiratory volume in 1 second (FEV_1) and best forced vital capacity (FVC), using American Thoracic Society (ATS) criteria.[15] The patients' results were compared with the third National Health and Nutrition Examination Survey reference values for predicted FEV_1 values.[16]

Patients were defined as having COPD if they had a post-bronchodilator FEV_1/FVC ratio < 0.7. Severity of COPD was classified using the Global Initiative for Chronic Obstructive Lung Disease (GOLD) stages, from Stage 1 (mild) to Stage 4 (very severe).[4] Normal spirometry was defined as a pre-bronchodilator FEV_1/FVC ratio ⩾ 0.7 AND a pre-bronchodilator FEV_1 ⩾ 80% predicted. Asthma was defined as a change in FEV_1 after bronchodilator ⩾ 200 mL AND ⩾ 12% of baseline. COPD and asthma labels were not mutually exclusive.

Statistical analysis

Baseline characteristics were described as means or frequencies for each patient category, adjusted for clustering at the GP level using the SAS procedures SURVEYMEANS and SURVEYFREQ (SAS 9.2; SAS Institute, Cary, NC, USA). Univariate *P* values for comparisons of means and frequencies between the groups who did and did not have a post-bronchodilator FEV_1/FVC ratio < 0.7 were calculated and adjusted for clustering at the GP level using mixed regression and PROC SURVEYFREQ.

The independent effect of each practitioner, practice and patient characteristic on the probability of agreement between clinical diagnosis and post-bronchodilator FEV_1/FVC ratio < 0.7 was estimated using a generalised linear mixed model implemented in the SAS procedure PROC GLIMMIX. This procedure adjusts for clustering at the GP level. We estimated odds ratios using a logistic link and binary error structure. Collinearity among the covariates was tested for and found not to be present. $P < 0.05$ was considered significant.

1 Characteristics of 445 participating patients, by spirometric diagnosis

			Non-COPD diagnoses			
	COPD ± asthma (*n* = 257)	No COPD (*n* = 188)	Asthma only (*n* = 16)	Normal spirometry (*n* = 82)	Other* (*n* = 90)	*P*†
Mean age (SD)	67.1 (9.7)	62.2 (10.5)	64.0 (8.0)	60.2 (10.1)	63.8 (11.0)	0.08
Male	134 (52.1%)	82 (43.6%)	6 (37.5%)	29 (35.4%)	47 (52.2%)	0.06
Current smoker	83 (32.3%)	52 (27.7%)	5 (31.3%)	26 (31.7%)	21 (23.3%)	0.30
Australian-born	109 (42.4%)	90 (47.9%)	11 (68.8%)	42 (51.2%)	51 (56.7%)	0.27
Mean number of comorbidities (SD)	3.6 (2.1)	4.3 (2.5)	3.7 (2.3)	4.0 (2.6)	4.6 (2.3)	0.05
Used at least one respiratory medication	234 (91.1%)	144 (76.6%)	15 (93.8%)	59 (72.0%)	72 (80.0%)	< 0.001
Used tiotropium	144 (56.0%)	57 (30.3%)	7 (43.8%)	17 (20.7%)	33 (36.7%)	< 0.001
Used at least one long-acting bronchodilator	211 (82.1%)	118 (62.8%)	14 (87.5%)	45 (54.9%)	59 (65.6%)	0.03
Used inhaled corticosteroids	169 (65.8%)	94 (50.0%)	12 (75.0%)	34 (41.5%)	48 (53.3%)	0.001
Mean COPD knowledge score (SD)	8.8 (1.5)	9.0 (1.3)	9.2 (1.3)	8.9 (1.5)	9.0 (1.2)	0.33
Influenza vaccination	186 (72.4%)	120 (63.8%)	8 (50.0%)	47 (57.3%)	65 (72.2%)	0.05
Pneumococcal vaccination	167 (65.0%)	89 (47.3%)	5 (31.3%)	37 (45.1%)	47 (52.2%)	< 0.001
Attended pulmonary rehabilitation	24 (9.3%)	5 (2.7%)	0	1 (1.2%)	4 (4.4%)	0.005
Mean SGRQ overall score (SD)	44.5 (17.5)	38.3 (20.0)	41.8 (19.3)	32.2 (20.3)	43.1 (18.6)	0.01
Mean SGRQ symptoms score (SD)	53.7 (20.6)	47.1 (22.9)	56.2 (28.8)	41.7 (22.0)	50.4 (21.6)	0.002
Mean SF-12 PCS score (SD)	35.6 (11.0)	38.1 (12.7)	35.6 (11.1)	40.9 (12.8)	35.9 (11.8)	0.01
Mean SF-12 MCS score (SD)	49.7 (11.6)	48.4 (11.6)	46.0 (12.3)	48.8 (11.3)	48.6 (11.9)	0.78
Hospital attendance for respiratory condition	10 (3.9%)	4 (2.1%)	0	2 (2.4%)	2 (2.2%)	0.25

COPD = chronic obstructive pulmonary disease. SGRQ = St George's Respiratory Questionnaire. SF-12 = 12-item Short Form Health Survey. PCS = Physical Component Summary. MCS = Mental Component Summary. * Such as restriction. † *P* value is for the difference between COPD and no COPD. ◆

RESULTS

Fifty-six GPs from 44 general practices in Sydney participated in the study. The mean age of GPs was 52.3 years, and 47 were male. Of the 56 GPs, 51 were vocationally registered (recognised as having specialty qualification in general practice), 30 were graduates of an Australian or New Zealand university, and they had a mean of 15.6 years' (range, 1–35) experience in practice. Forty-seven of the GPs worked in accredited practices, 40 had a spirometer in the practice, 25 had a practice nurse and 45 had a practice manager.

The record search and review of the list generated by the GPs identified 1144 patients who were eligible and invited to participate. Of these, 445 patients (38.9%) were recruited and provided baseline data. The mean age of participants was 65.0 years, and 217 (48.8%) were male. The mean number of comorbidities was 3.9 (range, 0–14). More than half (55.1%; 244/443) were born in Australia, and 30.5% (134/440) were current smokers.

Of the 445 patients, 257 (57.8%) had post-bronchodilator spirometry showing COPD with or without asthma, 16 (3.6%) had asthma only, 82 (18.4%) had normal spirometry, and 90 (20.2%) had other spirometric diagnoses such as restriction. Of the patients with COPD, 33 (12.8%) had GOLD Stage 1, 118 (45.9%) had Stage 2, 79 (30.7%) had Stage 3 and 27 (10.5%) had Stage 4, by post-bronchodilator spirometry. The characteristics of all participating patients are shown in Box 1 by spirometric diagnosis. Patients who had COPD on spirometry tended to be older, male and have fewer comorbidities. There were significant differences between those with and those without COPD in terms of treatment received, disease-related quality of life and overall quality of life.

The associations between practitioner, practice and patient factors and having airflow obstruction on spirometry are shown in Box 2. There were three statistically significant associations. Having a practice manager in the general practice was associated with a higher chance of misdiagnosis. Older patients were more likely to be correctly diagnosed, and those with higher numbers of comorbidities were less likely to be correctly diagnosed.

2 Predictors of agreement between clinical diagnosis of COPD and post-bronchodilator airflow obstruction on spirometry ($n = 445$)

Characteristic	OR (95% CI)	*P*
Practitioner		
Male	0.76 (0.25–2.30)	0.63
Vocationally registered	1.36 (0.16–11.69)	0.78
Overseas graduate	0.79 (0.40–1.53)	0.49
Practice		
Accredited	1.58 (0.54–4.66)	0.40
Spirometer	1.80 (0.79–4.08)	0.16
Nurse	1.02 (0.47–2.19)	0.96
Manager	0.37 (0.15–0.90)	0.03
Solo practice	1.14 (0.43–3.00)	0.79
Patient		
Older age	1.86 (1.42–2.44)	< 0.001
Male	1.33 (0.82–2.17)	0.25
Australian-born	1.34 (0.81–2.22)	0.26
Higher no. of comorbidities	0.83 (0.74–0.93)	0.002
Non-smoker	0.65 (0.38–1.13)	0.13

COPD = chronic obstructive pulmonary disease. OR = odds ratio. ◆

DISCUSSION

We found that there are substantial rates of misdiagnosis of COPD in primary care, with less than 60% of patients having the clinical diagnosis confirmed on spirometry. This has important implications for management, including using medicines to treat COPD in patients who do not have the condition. In this study, 57 of the 188 patients who did not have COPD on spirometry were being treated with tiotropium. This exposes patients to unnecessary risk of adverse effects of medications and has cost implications for the patients and the health system. It also means that the true cause of a patient's respiratory symptoms may not be correctly identified and treated.

Our findings confirm those from previous studies in primary care. In a study in Greece of 319 patients aged over 40 years diagnosed as having COPD, 50% had a post-bronchodilator FEV_1/FVC ratio < 0.7.[10] A similar rate was found in a study in primary care practices in Scotland and the United States,[11] where 48% of patients with a prior diagnosis of chronic bronchitis or emphysema were confirmed as having COPD on post-bronchodilator spirometry. In a study of 580 patients on a general practice-based COPD register in England,[12] 79% had obstruction on pre-bronchodilator spirometry. Reversibility testing was not done for all patients in that study, so this may be an overestimate of the prevalence of COPD. In a Canadian study, where spirometry was more often used in clinical practice, the rate of misclassification was lower (12% of patients aged over 40 years).[13]

Our study adds to previous research in that we looked for characteristics of practitioners, their practices and patients that are associated with diagnostic accuracy. The striking finding is that presence of a spirometer in the practice was not associated with diagnostic accuracy. It may be that spirometers are not being used because of time limitations or lack of adequate financial reward, or that there are problems with the quality of spirometry performed in general practice. Qualitative research in Tasmania found that GPs preferred to diagnose COPD on clinical grounds and there were both organisational and technical barriers to greater use of spirometry.[7] A study in the United Kingdom found that, despite incentives to perform spirometry, lack of adequate training in its use and interpretation meant that diagnosis was more likely to be made on clinical grounds.[17]

The only practice factor significantly (and negatively) associated with diagnostic accuracy was the presence of a practice manager. We are unable to explain this, as practice managers have no role in the diagnostic process, and believe it must be a chance finding. Although practice managers were more likely to be working in larger practices, which are in turn likely to have more doctors in training, this is unlikely to explain the association as there was no difference found in diagnostic accuracy between solo and group practices.

The other important finding was that presence of comorbidities was significantly associated with diagnostic inaccuracy. As accurate spirometry should be possible despite comorbidities, this has implications for practice as it suggests that patients with comorbidities should be prioritised for thorough investigation. Older age was associated with higher diagnostic accuracy, presumably due to increased prevalence of COPD with age.

A recent study found that the likelihood of misclassification increased with overweight or obesity and self-reported allergic rhinitis or hayfever,[18] but did not report a relationship with the number of comorbidities. Consistent with our study, it found decreased likelihood of misclassification with increasing age.[18] The investigators did

not examine for practice and practitioner factors associated with misclassification.

A limitation of our study is that we did not have information on how the diagnosis of COPD was made in the patients. It could be that patients had been diagnosed on the basis of clinical features and had not had spirometry, particularly as there are barriers to the use of spirometry in primary care. Another possibility is that the spirometry done by the treating clinicians or by the study team was incorrect or involved poor patient technique. We are confident in the quality of the spirometry done for the study as the project officers had substantial training and expert oversight. The ATS criteria that require three acceptable expirations were achieved for the patients in our study, so poor technique was not a factor.

While it was possible to withhold treatment with bronchodilators before spirometry, it was not possible to withdraw inhaled corticosteroids, and some patients treated with these medicines may have met the criteria for COPD if they had not been using this treatment. Similarly, tiotropium was not withheld for 24 hours or more in every patient, so it is possible that a small number of patients with mild obstruction when not being treated may have had normal spirometry.

Until an alternative to spirometry is found, there is a need to develop and evaluate strategies to encourage its use and improve its quality in the diagnostic process of patients seen in general practice. A policy issue is the low level of remuneration received for performing spirometry (the current Medicare rebate is $16.85 for pre- and post-bronchodilator spirometry). Another issue is the availability of appropriately trained workforce to perform spirometry in primary care. Up-skilling of practice nurses is an option, as there is evidence that nurses can take on this role,[19-21] but training and quality assurance are needed, along with adequate funding.[9]

An approach arising from this study could be to prioritise patients with comorbidities for thorough diagnostic assessment, including spirometry, as this group may be more likely to be incorrectly diagnosed. As demonstrated in research in Tasmania,[22] patients are presenting to their GPs with respiratory symptoms, but a substantial number do not have either COPD or asthma. Thus, there is also a need to better understand the nature and causes of respiratory symptoms in patients in general practice.

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COMPETING INTERESTS

None relevant to this article declared (ICMJE disclosure forms completed).

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