RESEARCH PAPER

Accuracy of asthma and COPD diagnosis in Australian general practice: a mixed methods study

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Abstract

Background: Spirometry is the 'gold standard' for diagnosing asthma and chronic obstructive pulmonary disease (COPD) but is rarely used in general practice.

Aims: To compare doctor diagnoses with patient reports/spirometry and to determine doctors' perceptions of spirometry.

Methods: Patients prescribed inhaled medication were recruited from 31 practices. Doctor diagnoses were extracted from practice records. Patients completed a questionnaire and spirometry before and after bronchodilator. In-depth interviews were conducted with a sample of doctors.

Results: Doctor diagnoses were available for 278 patients: asthma 192 (69%), COPD 38 (14%), asthma/COPD 40 (14%), and eight patients (3%) with other conditions. The diagnosis of asthma was correctly reported by 93% of patients, but only by 61% of those with COPD alone. Among those with both diagnoses, 83% reported asthma and 48% reported COPD. Of those with a diagnosis of COPD, 65% had fixed airflow limitation. Conversely, only 14% of those had been diagnosed with COPD alone. There was no significant difference in reversibility in forced expiratory volume in 1 second between diagnoses. While recognising the value of spirometry in differentiating between asthma and COPD, most general practices only used spirometry in diagnostically difficult cases.

Conclusions: Doctor-diagnosed asthma is accurately reported by patients. However, COPD remains substantially under-diagnosed. Spirometry needs to be more widely used to improve the accuracy of respiratory diagnoses in general practice.

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See linked editorial by Sims & Price on pg 128

Introduction

The diagnosis of both asthma and chronic obstructive pulmonary disease (COPD) in specialist practice is based on a combination of clinical history and lung function tests. Although results may be normal between attacks, spirometry is considered the lung function test of choice for diagnosing asthma in adults.¹

Spirometry before and after bronchodilator is also recommended in children aged 7 and over to confirm the diagnosis of asthma.¹ Furthermore, the diagnosis of COPD rests on the demonstration of airflow limitation which is not fully reversible.² Post-bronchodilator spirometry remains the gold standard in COPD guidelines,³ yet in Australia spirometry is rarely carried out in general (family) practice.⁴

The detection of previously undiagnosed cases of asthma

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and COPD has been investigated in European general practices. The combination of screening spirometry and follow-up for 2 years was found to be feasible and cost effective in the Netherlands.⁵ However, spirometry performed in a general practice setting was found to be associated with large random errors and tended to underestimate the longitudinal decline in lung function.⁶ Another study of 20 Belgian general practitioners (GPs) found that early cases of COPD could be detected with office spirometry.⁷ A further study of 26 Belgian practices found that less than 33% of patients with presumed obstructive airways disease had spirometry during the preceding 2 years.⁸ The GPs were uncertain about the diagnosis in almost half their patients on inhaled therapy.

Thus, questions remain about the value of spirometry for diagnosing asthma and COPD in general practice. The aims of this analysis were (1) to compare doctor diagnoses with patient reports; (2) to compare doctor diagnoses with spirometry in a sample of general practice patients; and (3) to determine doctors' perceptions of their own use of, and the value of, spirometry for diagnosis.

Methods

The study design and recruitment of practices and participants have been described in detail in a previous paper from the SPIRO-GP trial.⁹ Briefly, we conducted a 12-month cluster randomised controlled trial of spirometry with regular medical review in 31 general practices from Melbourne and the surrounding regions. Eligible patients were those of participating practices who had been prescribed any inhaled medication in the preceding 6 months, were aged 8–70 years, and able to understand English. The study was approved by the Standing Committee on Ethics in Research Involving Humans at Monash University and all participants (or their parents) provided written informed consent.

Doctors' diagnoses were extracted from the medical records of participating general practices. Patient-reported symptoms, history, and medication were obtained from a slightly modified version of the main European Community Respiratory Health Survey (ECRHS) questionnaire¹⁰ ([www.ecrhs.org/ECRHS I/main questionnaire.pdf](http://www.ecrhs.org/ECRHS%20I/main%20questionnaire.pdf)) administered at baseline. Asthma control was assessed with the 4-item Asthma Control Test¹¹ – these data have been published elsewhere.¹²

Spirometry was performed in the practice by a trained respiratory scientist with a Micromedical electronic turbine spirometer (SPIRO USB 36-ML2525, Cardinal Health, Basingstoke, UK) before and after salbutamol in accordance with ATS/ERS guidelines.¹³ Measured forced expiratory volume in 1 second (FEV₁) and forced vital capacity (FVC) were compared with values predicted from the National Health And Nutrition Examination Survey.¹⁴ The results were interpreted by a respiratory physician or paediatrician following ERS/ATS recommendations¹⁵ and faxed back to the practice within days or at the end of the trial.

Qualitative methods

In-depth audio-recorded telephone interviews were conducted after completion of the randomised controlled trials with GPs from each arm of the trial to gain insight into their views about the value of using spirometry in general practice. Content and thematic analyses were performed on the interview transcripts.¹⁶ Thematic analysis of each interview and comparisons across interviews provided a number of key themes irrespective of the arm of the study.

Statistical methods

Statistical analyses were performed in SPSS version 15 (SPSS Inc, Chicago, IL, 2006). Doctor diagnoses were compared with patient reports and spirometric categories in contingency tables. Because of skewed distributions, inhaled steroid dose and reversibility were compared between diagnostic categories with the Kruskal-Wallis test. Reproducibility over 12 months was assessed with Cohen's κ and marginal homogeneity with McNemar's test. Associations with diagnosis were assessed with Fisher's exact tests. *p* values <0.05 were considered statistically significant.

Results

The study recruited 305 adult patients (101 males, 204 females) with a mean (SD) age of 54 (12.8) years. Doctor diagnoses were available for 278 patients: asthma in 192 patients (69.1%), COPD 38 (13.7%), asthma/COPD 40 (14.4%), and eight patients (3%) with other conditions (including pulmonary fibrosis, bronchiectasis, and undiagnosed cough). Demographic characteristics and treatment are described in Table 1. Patients with a diagnosis of asthma were significantly younger (*p*<0.0001) and more likely to be female (*p*=0.004). Those with a diagnosis of COPD were significantly more likely to be current smokers (*p*<0.0005). Those with a diagnosis of asthma with or without COPD were more likely to be prescribed long-acting β_2 -agonists (LABA, *p*=0.016). However, there was little difference between groups in the prescription of combination LABA/steroid inhalers. The highest median daily dose of inhaled steroid was observed in the group with asthma/COPD (*p*=0.011).

A doctor diagnosis of asthma was correctly reported by 93% of patients with asthma (Table 2). However, a doctor diagnosis of COPD was only reported by 61% of patients diagnosed with COPD alone (Table 3). Of the group with both diagnoses, 83% reported asthma and 48% reported COPD.

Spirometry was performed at baseline in 199 adult patients for whom a doctor diagnosis was available. Descriptive statistics for pre- and post-bronchodilator FVC, FEV₁ and FEV₁/FVC% are given in Table 4. Fixed airflow limitation (post-bronchodilator FEV₁/FVC% <0.7) was found in 91 patients (45.7%). It was demonstrated in 65% of patients diagnosed with COPD, but also in 37% of those diagnosed with asthma (Table 5). Conversely, only 14% of those meeting this criterion had been diagnosed with COPD alone. When spirometry was repeated after 12 months in 177 patients, fixed airflow limitation was

Table 1. Description of patient demographics and treatment (note numbers do not add up to 278 for all variables because of missing data)

	Asthma (n=192)	COPD (n=38)	Asthma/COPD (n=40)	Other (n=8)
Mean (SD) age, years	51.9 (12.9)	61.7 (7.0)	60.2 (6.4)	61.4 (9.4)
Gender, n (% male)	53 (27.9%)	20 (55.6%)	18 (45.0%)	3 (37.5%)
Smoking				
Never	101 (55.2%)	6 (19.4%)	7 (17.9%)	3 (37.5%)
Former	62 (33.9%)	15 (48.4%)	18 (46.2%)	5 (62.5%)
Current	20 (10.9%)	10 (32.3%)	14 (35.9%)	0 (0%)
Long-acting β -agonist	110 (57.9%)	14 (38.9%)	29 (72.5%)	3 (37.5%)
Combination inhaler	79 (62.7%)	10 (62.5%)	20 (62.5%)	3 (75.0%)
Inhaled steroid alone	47 (37.3%)	6 (37.5%)	12 (37.5%)	1 (25.0%)
Median (IQR) inhaled steroid dose (μ g budesonide/day)	1000 (800, 2000)	1000 (450, 2000)	2000 (1000, 2000)	900 (500, 1500)

COPD=chronic obstructive pulmonary disease.

Table 2. Doctor diagnosis when the patient reported asthma

Doctor diagnosis	Yes	No	Total
Asthma	177 (93.2%)	13 (6.8%)	190
COPD	9 (25%)	27 (75%)	36
Asthma/COPD	33 (82.5%)	7 (17.5%)	40
Other	3 (37.5%)	5 (62.5%)	8
Total	122	52	274

COPD=chronic obstructive pulmonary disease.

Table 3. Doctor diagnosis when the patient reported COPD

Doctor diagnosis	Yes	No	Total
Asthma	7 (3.7%)	183 (96.3%)	190
COPD	22 (61.1%)	14 (38.9%)	36
Asthma/COPD	19 (47.5%)	21 (52.5%)	40
Other	2 (25%)	6 (75%)	8
Total	50	224	274

COPD=chronic obstructive pulmonary disease.

Table 4. Descriptive statistics for spirometry (n=199)

	Pre-bronchodilator		Post-bronchodilator	
	Mean (SD)	%predicted	Mean (SD)	%predicted
FVC (L)	3.29 (1.00)	88.2 (16.5)	3.45 (1.00)	92.6 (15.3)
FEV ₁ (L)	2.21 (0.84)	75.8 (21.9)	2.36 (0.85)	81.1 (20.9)
FER (%)	66.6 (14.0)		68.4 (14.2)	

FVC=forced vital capacity, FEV₁=forced expiratory volume in 1 second, FER=forced expiratory ratio (FEV₁/FVC).

Table 5. Doctor diagnosis by fixed airflow limitation (post-bronchodilator FER <0.7)

Doctor diagnosis	Yes	No	Total
Asthma	51 (37%)	87 (63%)	138
COPD	13 (65%)	7 (35%)	20
Asthma/COPD	25 (69.4%)	11 (30.6%)	36
Other	2 (40%)	3 (60%)	8
Total	91	108	199

COPD=chronic obstructive pulmonary disease, FER=forced expiratory ratio (FEV₁/FVC).

highly reproducible (Table 6, $\kappa=0.82$, $p<0.001$). Although slightly more patients lost than developed fixed airflow limitation, this difference did not quite achieve statistical significance ($p=0.08$).

The reversibility in FEV₁ after bronchodilator ranged from -5.0% to +56.2% with a median (interquartile range) of +5.9% (2.4–11.6%). The median (interquartile range) absolute increase in FEV₁ was 130mL (40–220mL). The combination of a post-bronchodilator increase in FEV₁ $\geq 12\%$ and ≥ 200 mL was demonstrated by 36 patients (18.2%), but this was not associated with diagnosis ($p=0.7$). Although some of those with a doctor diagnosis of asthma demonstrated outlying and extreme values (Figure 1), overall there was no significant difference in reversibility between diagnostic groups ($p=0.5$). This lack of difference was not explained by age, gender, or reported use of LABA (data not shown). Those with poorly

Table 6. Reproducibility of fixed airflow limitation (post-bronchodilator FER <0.7) over 12 months

At 12 months	No	Yes	Total
No	94 (88.7%)	12 (11.3%)	106
Yes	4 (5.6%)	67 (94.4%)	71
	98	79	177

FER=forced expiratory ratio (FEV₁/FVC).

controlled asthma had greater reversibility than those with well or totally controlled asthma (median 8.7% vs. 4.5%, $p=0.037$).

Qualitative data

The views of GPs from the intervention, spirometry only, and control groups on using spirometry are reported in Box 1. Both content and thematic analyses indicated that, irrespective of the

Figure 1. Bronchodilator reversibility in forced expiratory volume in 1 second (FEV₁) by doctor diagnosis. The boxplot displays the distribution of data. The horizontal line represents the median (mid) value, the hinges of the box the interquartile (25–75%) range, and the whiskers the range from the minimum to maximum values

group from which they were drawn, most of the GPs interviewed did not regularly refer patients for spirometry to assist with diagnosis. When asked whether they normally referred patients for spirometry or undertook spirometry of patients, the answer from 14 of the 16 GPs interviewed was 'not often'. Most commented that the use of spirometry was only necessary when they perceived themselves to be 'struggling with the diagnosis' or felt that the diagnosis was 'more complicated' or they needed confirmation of the diagnosis. Content analysis indicated that

they believed they were more likely to refer those who had not previously had spirometry, to assess reversibility, to encourage smoking cessation, for preoperative assessment, or when requested by the patient. Cost – both in terms of potential financial loss and time loss – were key concerns for the GPs choosing not to use spirometry. These findings are reported in Boxes 2 and 3, respectively.

Discussion

Main findings

This is one of relatively few studies of the diagnosis of chronic respiratory diseases to be conducted in Australian general practices and the first to use mixed research methods. We found that doctor-diagnosed asthma was generally accurately reported by adult patients. However, there was substantial under-reporting by patients and under-diagnosis by doctors of COPD. Some of the discrepancies between patients and doctors may have arisen from communication problems and/or misunderstanding during medical consultations. The average GP consultation in Australia lasts only 6 mins. Although the COPD-X guidelines were first published 8 years ago² and the Australian Lung Foundation has conducted a marketing campaign, the term COPD is still not well understood in the wider community.

Although all chronic airflow obstruction that is poorly reversible can be labelled as COPD, it is a non-specific physiological manifestation which can be the end result of multiple and often very different conditions. Chronic asthma,¹⁷ tuberculosis, bronchiectasis, cystic fibrosis, sarcoidosis, and multiple other pathologies can all give rise to irreversible airflow

Box 1. General practitioners' views of using spirometry for diagnosis

Interviewer: Prior to the study, would you have referred many patients for spirometry?

Respondent: It depends on the circumstances. ... If I get anybody who has not had spirometry I tend to get them to have spirometry (Male GP3A)

Interviewer: And prior to the spirometry study we have been undertaking, would you have referred many patients for spirometry prior to this study?

Respondent: No, no. (Male GP5A)

Interviewer: In the past, prior to the spirometry study, would you have referred many patients for spirometry?

Respondent: Very few indeed.

Interviewer: And if you did refer them, why would you refer them?

Respondent: Usually out their own urging, I would say.

Interviewer: Because they are wanting to know more?

Respondent: Mm. (Male GP27A)

Interviewer: All right, and would you refer for spirometry very often?

Respondent: Not very often, no. (Female GP08B)

Interviewer: Prior to the study, would you refer patients for spirometry very often?

Respondent: Not often.

Interviewer: And if you did refer them, why would you refer someone for spirometry?

Respondent: Sometimes just for general assessment like if they presented with asthma just to have an idea or especially in sort of younger adults who had asthma who also smoked, to see what proportion is reversed, like whether they were starting to get obstructive airways disease ... If they already had pre-existing asthma but also who had been smokers, to have an assessment whether now they also had a component of obstructive airways disease, and sometimes – so some on patient requests that they wanted their asthma assessed, and sometimes to check the severity. If someone has obstructive airways disease or mixed asthma and obstructive airways disease, to check the severity and to see if they now would now benefit from having, you know, like respiratory treatment. (Female GP14B)

Interviewer: Now, prior to this spirometry study ... did you refer patients with spirometry very often?

Respondent: Look, occasionally. We've had a spirometer for a number of years, and as everybody tells us it's probably underused. So, occasionally.

Interviewer: And why would you refer a patient for spirometry?

Respondent: I suppose when it's been unclear whether people have asthma, maybe younger people, if it's been unclear whether people have asthma. I've mainly used it as a diagnostic tool for asthma. I haven't used it so much as a tool for people whom I suspect of having COPD. (Male GP24B)

Box 2. General practitioners' views of financial costs of using spirometry

Interviewer: And what about – do you know much about the MBS items for spirometry?

Respondent: They're minuscule ... Barely worth doing.

Interviewer: I know.

Respondent: The only reason you do it is because it's a useful piece of information for you to have. You don't do it for the rebate. (Female GP8B)

Interviewer: Is that through the National Asthma Council? I think division is working with the National Asthma Council. They would be terrific if the funding continued. What did you feel about the MBS item number or numbers for spirometry?

Respondent: I'm sorry, I don't know. (Male GP3A)

Interviewer: Apparently it's not very much. It's about \$16 or it might be a little bit more now, \$17 or \$18, so a lot of GPs don't feel it is worthwhile to have a spirometer themselves but do feel that having someone come in every few months is far more viable.

Interviewer: Mm. So staff ...

Respondent: We've had spirometry services offered to us for nothing for the good of our patients. Give us a break. We do mental health for nothing for the good of our patients, primary mental health team, a psychiatric nurse. We're constantly doing things for nothing, and unless there is some form of remuneration we certainly wouldn't be trying to put a service into the building for free rent and free labour and free heating and free phones and free staff to book patients and all that sort of thing, not my model. (Male GP24B)

Interviewer: That's good. The MBS item numbers, I suppose need to be considered.

Respondent: Yes

Interviewer: Remuneration for spirometry isn't ...

Respondent: Not huge, I don't think.

Interviewer: No, it's not huge, but I think that puts quite a few GPs off.

Respondent: I can't recall the amount. I think it's in the order of \$25 or - -

Interviewer: Oh, I don't even think it's that much.

Respondent: I actually couldn't tell you, but I mean ... what's a spirometer worth, \$1500 or - - ?

Interviewer: Yes, yes, I think about that much.

Respondent: You would need to generate a lot of - -

Interviewer: A lot of work to cover it. (Male GP2C)

MBS=Medical Benefits Schedule (www9.health.gov.au/mbs/fullDisplay.cfm?type=item&q=11506&qt=ItemID)

Box 3. General practitioners' views of time costs of using spirometry

Interviewer: Yes, and I know that there are courses now available at [Hospital A], but, look, some GPs find it easier to send them off-site.

Respondent: It is. Really it's a question of time. I suppose if you get someone to do it for us. We do have practice nurses here as well but, they're pretty flat chat as well, and by the time you do a proper test, maybe 20 minutes of time, and that probably is too much. (Male GP23C)

Interviewer: Of course, there are other options – I don't know whether you have a practice nurse working in the practice, do you?

Respondent: We do.

Interviewer: You know there are courses available ...

Respondent: Our practice nurses are absolutely snowed under with their current workload.

Interviewer: I'm sure they are.

Respondent: If you added a respiratory function to it, they'd quit.

Interviewer: Oh, yes I've heard that too.

Respondent: Don't worry, one of them asked at one stage and she's never asked since. (Female GP16C)

Interviewer: That's an expensive ornament.

Respondent: It's a very expensive ornament, but, it does ... even the best of goodwill, we're all so busy, there needs [to be] some process of education and learning and teaching everyone around the use of it. It's not that we couldn't use it, or it wouldn't work with our computer system, but I suppose in terms of the resources it would be better to have a community shared resource where all the GPs could send a patient rather than us all trying to keep ourselves up-to-date, maintain equipment, provide facilities, appointment books, all that sort of thing ... (Male GP24B)

Respondent: Yes, but, you don't know whether – how matching the demand with the supply of services doesn't always work because it's not something you're going to do all the time.

Interviewer: No.

Respondent: And so you might say to someone come once a month. You might not have enough work for them once a month.

Interviewer: Yes.

Respondent: But, then you might have three in one week so that's kind of like that.

Interviewer: Yes, would you ever – obviously with those low numbers you wouldn't consider training somebody to come in to work with you for performance spirometry.

Respondent: No. (Male GP35C)

obstruction, but labelling them as COPD because of this could be considered diagnostic duplicity.¹⁸ It is not the sole diagnostic criterion for this condition, as the full Global Initiative for Chronic Obstructive Lung Disease (GOLD) definition recognises that airflow limitation in COPD is usually progressive and associated with an abnormal inflammatory response of the lung to noxious

particles or gases.¹⁹ Furthermore, significant extrapulmonary effects are also recognised that contribute to the severity of COPD in individual patients. Some patients can have symptoms of chronic bronchitis without fixed airflow limitation but they are unlikely to have significant COPD.²⁰ Nonetheless, fixed airflow limitation was highly reproducible over 12 months in our trial.

The small number of patients who no longer had fixed airflow limitation probably had asthma which either responded to intensified medical management or improved spontaneously.

Although promoted as part of the GOLD and COPD-X guidelines for diagnosis, the use of a fixed FEV₁/FVC ratio to define airflow obstruction has been a subject of considerable debate in the medical literature. It is well known that the FEV₁/FVC ratio declines with increasing age and height, even in healthy lifelong non-smokers in whom the lower limit of normal (LLN) drops below a ratio of 0.7 from about 45 years of age. Hence, using a fixed ratio can lead to over-diagnosis or misclassification above that age. Furthermore, adult smokers suspected of having COPD are not at increased risk of respiratory symptoms, respiratory morbidity, or all-cause mortality until the ratio falls below the age-corrected fifth percentile LLN range.²¹ Using the LLN values for FEV₁/FVC that are based on the normal distribution and classifying the bottom 5% of the healthy population as abnormal has therefore been suggested as an alternative way to minimise potential misclassification.²²

The absence of any significant difference between diagnostic groups in reversibility to bronchodilator was surprising. All participants were advised to withhold short-acting β_2 -agonists for 4hrs, and LABA, combination inhalers or anticholinergics for 12hrs prior to testing. Spirometry was performed by a trained respiratory scientist in accordance with ATS/ERS guidelines. We therefore do not think this finding has arisen as a result of measurement error or artefact. Reversibility may have been obscured by good asthma control in some patients. However, the most likely explanation is that the diagnosis of chronic respiratory diseases was quite inaccurate in the participating general practices. A Canadian study found that asthma was over-diagnosed and could be excluded in 29% of normal weight subjects and 32% of obese subjects with physician-diagnosed asthma.²³

Qualitative data

In light of the GP interviews, one potential explanation of this inaccuracy is that some GPs may be over-confident in their diagnostic skills for differentiating between chronic respiratory diseases. In addition, most regarded the use of spirometry predominantly as a means of improving management ('convincing the patient that their lungs are not that good and they need to stop smoking') rather than as standard means of diagnosis.

This study tested the model of a 'mobile lung function laboratory' in the practice with careful attention to calibration of equipment, quality control, and prompt specialist interpretation. Alternative models have been trialled for performing spirometry in primary care. Walters *et al.* compared visiting trained nurses with usual care from GPs in Tasmania.²⁴ The nurses tested a significantly higher proportion of eligible patients and performed better quality spirometry than GPs giving usual care. However, there was no difference in the proportion of patients newly diagnosed with COPD. A randomised controlled trial in Dutch

family practices found that spirometry resulted in a change in diagnosis in around half of all patients.²⁵ However, there was little difference between spirometry interpreted by a chest physician, expert software support, or the GP. The Alliance Project has investigated telespirometry in Italian general practices with rapid reporting by a pulmonary specialist.²⁶ This project found severe obstruction in some symptomatic undiagnosed patients and also misdiagnosis of COPD in patients with normal spirometry.

Few previous studies have used qualitative or mixed research methods. However, Roberts *et al.* investigated why spirometry was underused in the diagnosis of breathless patients by conducting focus groups with British medical students, junior hospital doctors, GPs, and specialist trainees in respiratory medicine.²⁷ Only the GPs and specialist trainees spontaneously mentioned spirometry as a diagnostic tool. The junior doctors felt that there was a lack of encouragement, reinforcement, or basic information about spirometry. The medical students were unaware of how spirometry could be performed. Although GPs felt they had better access to spirometry than in the past, they saw a need for further training.

It is clear from our study of Australian GPs that there are other social determinants of spirometry use that go beyond simply improving knowledge of and/or skill in spirometry use. Funding arrangements, time constraints, and over-confidence in diagnostic skill without resort to technologies (except as a confirmatory tool) seemed also to influence the use of spirometry in the practices examined in this study. The key themes evident in our analyses of interviews suggest that, while improved training may be beneficial, other factors are equally important. Unless combined with attitudinal shifts among GPs about optimal management of diagnostic uncertainty, regular use in management, and improved funding for practices to contend with the real imposts of uptake, it is unlikely that spirometry in general practice will increase or assist in producing better diagnoses of asthma and COPD.

Limitations of this study

Our study has some limitations. Spirometry was not performed in all patients because the trial randomised nine practices to usual care. Some other data were also missing and no record of the diagnosis could be obtained for 27 patients. Recruitment was confined to Melbourne and surrounding regions. Eligible practices had to use electronic prescribing systems and be prepared to search for patients who had been prescribed inhaled medications. It is quite likely that those GPs who participated in the trial were more interested than many of their colleagues in the management of respiratory conditions. On the other hand, practices that already routinely used spirometry were excluded. So it is also possible that our findings reflect less accurate diagnosis than might occur in such practices. Overall, we need to be a little cautious about extrapolating the results to Australian general practice at large.

Conclusions

The results of this study support the more widespread use of

spirometry in general practice. We have demonstrated that the model of a 'mobile lung function laboratory' is feasible and can produce high quality lung function data. The mobile laboratories could be used effectively in Australian Primary Care Collaboratives (www.apcc.org.au/about_the_APCC). This would enable identification of the actions needed to bridge gaps in the appropriate use of spirometry in the diagnosis of asthma/COPD within each locality. The learning needs of GPs could be addressed by frequent structured workshops for members of each collaborative. The funding of mobile units should be integrated with a suitable incentive funding scheme. There are some important differences between the recommended management of asthma and COPD in adults, including the place of combination inhalers, written action plans, long-acting anticholinergics, and pulmonary rehabilitation. It is to be hoped that more accurate diagnosis would lead to improved management, fewer symptoms, better lung function, and better quality of life for patients with chronic respiratory diseases.

Handling editor Anthony D'Urzo

Statistical review Gopal Netuveli

Conflicts of interest Eleonora Del Colle is the Director of Pulmetrics Pty Ltd, the company that performed the spirometry for the study. She is also one of the principal authors of the National Asthma Council Spirometry Course for General Practitioners and has been presenting this course nationally over the last 18 months. All other authors have no conflict of interest to declare.

Contributorship MJA, NDS, EADC, RA and FT designed the trial and obtained funding. RLS coordinated the trial and data collection. MJA analysed the quantitative data and wrote the first draft of the paper. RA supervised the interviews and analysed the qualitative data. All authors contributed to the manuscript and approved the final version for publication.

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