

ORIGINAL ARTICLE

National survey of spirometer ownership and usage in general practice in Australia

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Objectives and background: Despite the lack of data, it is believed that spirometry is underutilized in general practice. The aim of the present study was to determine the availability of spirometry and the level of spirometry training in general practice throughout Australia and compare with international data.

Methods: In total, 5976 general practices throughout Australia were sent a questionnaire requesting details of spirometer ownership, usage and the level and source of spirometry training. To exclude response bias, a follow-up telephone survey was conducted of 160 practices that did not respond to the initial survey.

Results: Of practices 19.5% (1125) responded to the initial survey with 64.2% (722) of these owning a spirometer and 83.9% in the follow-up sample. Common reasons for not owning a spirometer were equipment cost (53.3%) and insufficient remuneration (32.8%). Most practices (67.0%) performed one or more tests per week. Practices commonly used spirometry to diagnose (89.5%) and manage (93.9%) asthma, assess breathlessness (83.4%) and to detect and manage other diseases such as COPD (77.7%). Spirometer accuracy was never checked using a syringe 77.8% of practices and 40% did not test a healthy subject as part of their quality assurance programme. Spirometry training was received most commonly through courses run by general practice organizations (38.2%), and the duration of training courses was <2 h in 40% of cases.

Conclusion: Despite high spirometer ownership in general practice, the frequency of use is low. Low rates of verification of spirometer accuracy and performance suggest the need for reliable, stable spirometers to be available to general practitioners. Regular and more comprehensive training in spirometry is needed.

Key words: general practice, spirometer ownership, spirometry training, spirometry.

INTRODUCTION

Spirometry is a well-established tool for detecting and quantifying airflow limitation and is an important component of national and international guidelines for the diagnosis and care of patients with asthma and COPD.^{1–3} These common diseases are largely diagnosed and managed within the primary care sector,^{4,5} although it is known that COPD in particular is widely

underdiagnosed.⁶ The use of spirometry for screening in general practice, especially in people at risk of developing respiratory disease (e.g. smokers), almost doubles the number of patients identified with airflow limitation, especially those with milder disease.⁶ This may lead to early detection of airflow limitation, facilitating earlier diagnosis and intervention.

Routine spirometry measurement by general practitioners is now feasible with widespread availability of computerized portable spirometers.⁶ Despite this, there is evidence that it is grossly underutilized.⁷ Qualitative studies have identified some factors that influence spirometry use in general practice: lack of training, lack of time, low remuneration and lack of access to a well-maintained spirometer.⁸ However, there appears to be no published data on the level of spirometer ownership, usage and training in Australian general practice.

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This study was conducted to determine the levels of spirometer ownership and usage in Australian general practice and the resources available for spirometry training and to compare this with overseas data. This information is important in formulating strategies to build capacity to perform and interpret spirometry in general practice.

METHODS

Quality in Practice Pty Ltd, a subsidiary of Australian General Practice Accreditation Limited (AGPAL), was contracted to conduct a survey to determine the level of spirometry use in general practice throughout Australia. A 22-item questionnaire covering spirometry ownership, use and training was developed in association with the Department of Health and Ageing and the National Asthma Reference Group of Australia (Appendix I). This was distributed in early 2004 to a total of 5976 general practices. The questionnaire was initially distributed to 2737 practices via email as an Excel spreadsheet for electronic return or as a PDF file that could be printed and posted or faxed back. However, of the initial 250 returned surveys only 30 were received via email. To avoid possible bias due to practices not having access to email, Excel (Microsoft) or PDF files, the questionnaire was faxed to all 5976 practices, including the initial 2737. An incentive of a chance to win a free registration to the Quality in Practice International Conference was offered.

In April 2004, a follow-up telephone survey was conducted on a random sample of 160 practices that did not respond to the survey to determine whether there was bias towards spirometer ownership in responses to the first survey.

All responses to the survey were entered into an Access (Microsoft) database for analysis.

RESULTS

Of the 5976 practices surveyed a total of 1166 completed the questionnaire, representing a 19.5% response rate. Of these 1166 responses, 1125 (96.5%)

were identified as AGPAL registered practices for which demographics were available. Therefore, only responses from these 1125 practices were analysed. One-third of respondents ($n = 377$, 33.5%) were from rural practices (Table 1). This is approximately equivalent to the percentage of rural practices represented on the AGPAL database.

Of the 1125 practices that responded to the survey, 722 (64.2%) owned a spirometer (Table 1). Spirometry ownership was highest in Queensland (83.8%) and Western Australia (76.3%). A significantly greater proportion ($P < 0.05$) of rural practices owned a spirometer ($n = 278$, 73.7%) than urban practices ($n = 444$, 59.4%). The highest rate of ownership (85.3%) occurred in practices employing six to ten full-time equivalent practitioners and the lowest by solo practices (52.2%).

Of the 403 (35.8%) practices that responded that they did not own a spirometer, 219 (54.4%) had considered purchasing one. Multiple reasons were given for not owning a spirometer (Table 2) with high equipment cost and insufficient medical insurance remuneration being the most common. Access to spirometry for these practices was said to be mainly through specialist physicians and hospital services.

Of the 722 practices that owned a spirometer, 643 (89.1%) provided specific details of the brand. The most commonly owned brands were the Welch Allyn (17.7%), Micromedical (17.2%), Cosmed (14.9%),

Table 2 Reasons for not owning a spirometer (eligible practices = 403)

	<i>n</i>	% Practices
High cost of spirometer	215	53.3
Insufficient Medicare rebate	132	32.8
Insufficient time to perform the test	85	21.1
Did not employ a practice nurse	91	22.6
Lacked confidence in interpreting results	72	17.9
Spirometry is not useful	22	5.5
Other reasons	42	10.4

Table 1 Response rates to the survey and spirometer ownership by region

	All practices that responded to survey ($n = 1125$)				Practices that own a spirometer ($n = 722$)		
	<i>n</i>	Fraction of all respondents (%)	Urban (%)	Rural (%)	<i>n</i>	Fraction of national ownership (%)	Fraction of state ownership (%)
Queensland	229	20.4	64.2	35.8	192	17.1	83.8
Western Australia	114	10.1	66.7	33.3	87	7.7	76.3
Tasmania	30	2.7	53.3	46.7	21	1.9	70.0
New South Wales	345	30.7	67.8	32.2	226	20.1	65.5
South Australia	129	11.5	65.1	34.9	76	6.8	58.9
Victoria	256	22.8	68.4	31.6	107	9.51	41.8
Northern Territory	7	0.6	14.7	85.7	5	0.4	71.4
Australian Capital Territory	15	1.3	100.0	0	8	0.7	53.3
National total	1125		66.5	33.5	722	64.2	—

Table 3 Reasons given for performing spirometry by practices that owned a spirometer (eligible practices = 722)

Reason for performing spirometry	No. responses	% Practices
Management of asthma patients	678	93.9
Diagnosing patients with asthma	646	89.5
Assessment of breathlessness/dyspnoea	602	83.4
Diagnosis and management of other respiratory diseases such as COPD	561	77.7
Screening current/ex-smokers	283	39.2
Other reasons	194	26.9

Fukuda (13.7%), Vitalograph (11.4%) and EasyOne (7.4%). In total, 83% of spirometers produce a permanent record of the trace. Multiple responses regarding the reasons for performing spirometry were received and are summarized in Table 3. The assessment of breathlessness and the diagnosis and management of patients with asthma and COPD were the most common responses. The number of spirometry tests performed varied widely with 29.2% performing more than five tests per week, 37.8% between one and five per week, 23.2% between one and four per month and 9.8% less than one per month.

Of the 722 practices that owned a spirometer 67.5% ($n = 487$) stated that they checked spirometer accuracy periodically, 44.0% annually, 17.2% monthly, 4.9% weekly and 1.4% daily. However, only 22.2% ($n = 108$) of these used a 3-L calibration syringe. Of practices 40% did not assess overall spirometer performance by measuring spirometry on a healthy subject. Only 45.3% responded to the question asking how frequently they performed this check with 76.8% of those who responded stating that they did this monthly. The person performing these quality assurance checks was usually a nurse (24.4%) or general practitioner (23.0%) although the non-response rate to this question was high (53.9%).

All practices responded to the question asking who conducts the spirometry tests with 30.2% ($n = 218$) stating that more than one person conduct this. The test was performed by a nurse in 63.6% ($n = 459$), general practitioner in 57.8% ($n = 417$) and by another person (e.g. receptionist, asthma educator) in 8.9% ($n = 64$) of practices. Interpretation was usually performed by a general practitioner (98.8%, $n = 713$), only 5.5% ($n = 40$) by a nurse with a small proportion (2.2%, $n = 16$) relying on the spirometer's interpretative software.

In terms of testing time, 19.8% ($n = 143$) of practices indicated that spirometry with reversibility testing took <10 min to perform, 58.7% ($n = 424$) between 10 and 20 min, and 19.9% ($n = 144$) more than 20 min. Almost all practices (98.6%, $n = 712$) reported taking precautions to minimize cross-infection between patients during spirometry; the remainder (1.4%, $n = 10$) stated that they used no precautions. More than one method of infection control was reported in 15% practices. In-line barrier filters were used by 27%

Table 4 Training received in the use of the spirometer and interpreting the results (eligible practices = 722, multiple responses)

	<i>n</i>	% Practices
Division of general practice	276	38.2
Royal College of General Practitioners	186	25.8
National Asthma Council of Australia	78	10.8
MB BS and during hospital residency	81	11.2
Equipment and/or pharmaceutical company	57	7.9
Hospital-based courses	37	5.1
Asthma courses	30	4.2
Other	124	17.2

($n = 194$), a new or disinfected mouthpiece by 84.5% ($n = 610$), and 1.1% ($n = 8$) use a mouthpiece with a one-way-valve or advised the patient not to inhale from the spirometer.

Training in the measurement and interpretation of spirometry had been received by all practices with a spirometer from a variety of sources (Table 4), with 22.3% stating more than one source. Resources used for self-directed learning included: spirometry CD, National Asthma Council of Australia website, spirometry textbook, seminars, spirometer operating manual and journals. The duration of training reported varied: <2 h (40.2%, $n = 290$), half a day (23.7%, $n = 171$), 1–2 days (11.4%, $n = 82$), and 3–5 days (6.7%, $n = 48$).

Almost one-third of respondents (32.3%, $n = 233$) indicated that they would definitely attend an accredited continuing professional development course, 30.5% ($n = 220$) stated that they probably would attend such a course and 21.1% ($n = 152$) that they may attend. Only 15.7% ($n = 113$) stated that they would not attend a continuing professional development accredited course.

Follow-up survey

Of the 160 practices randomly selected from those that did not respond to the original survey, 118 responded (73.8% response rate) to follow-up contact. The urban/rural mix and distribution across states was similar to the initial respondents. Of the follow-up respondents 83.9% ($n = 99$) owned a spirometer, which was significantly higher than the original respondents ($P < 0.001$).

DISCUSSION

This is the first study of spirometer ownership, usage and training in Australian general practice. Of general practices 64% owned a spirometer and almost 70% performed tests on a weekly basis for the diagnosis and management of respiratory diseases, particularly asthma and COPD. Only 10% performed less than one test per month. Access to a spirometer in general

practice has been reported in several recent studies. A low level of spirometer ownership, 23% of practices, was reported in a New Zealand study,⁹ but much higher rates, were found in two UK studies where 82.4%¹⁰ and 59% of general practitioners¹¹ owned a spirometer. Training varied widely, but 40% of practices received <2 h on measurement and interpretation, which is less than that shown to cause a significant improvement in the quality of spirometry.¹²

The study by Bolton *et al.* found that 42% of users lacked confidence in using a spirometer and 66% in interpreting results and this was an impediment to increasing the use of spirometry in general practice.¹⁰ In the present study only 18% of practices who did not own a spirometer said this was due to lack of confidence in interpreting results.

Spirometer guidelines recommend that the accuracy of a spirometer be checked regularly using a certified 3-L syringe.¹³ In the current study, although 67.5% of practices checked spirometer accuracy, less than a quarter used a syringe. This suggests confusion among many practitioners with respect to assessing spirometer accuracy. Many believe that measuring spirometry on a healthy subject is sufficient to check accuracy, which is inconsistent with accepted guidelines.¹³ It is clear that accuracy checks, if performed, are infrequent and suggests that even with a correctly performed test, there is potential for inaccuracy leading to misdiagnosis and misclassification. These data also suggest that training courses should place greater emphasis on the importance and means for achieving ongoing quality assurance. Spirometer accuracy and provision of feedback on the quality of each test has been recommended in a consensus statement from the American National Lung Health Education Program.¹ Although there is little direct evidence of cross-infection via lung function equipment, there is evidence that patients can contaminate the equipment. In this study, the vast majority of general practitioners who own a spirometer took some precautions to minimize cross-infection although these may not be adequate.

Australian Medicare insurance data on services for spirometry show that a total of 251 000 claims were made in 2003 with 176 200 of these from general practice. Although there are many caveats on these data, they still imply that spirometry is underutilized in general practices; when crudely expressed as a percentage of the Australian population the rate of spirometry testing in general practice is 0.9%, which is far lower than the Australian asthma prevalence rate alone. The authors identified insufficient medical insurance remuneration as one of the key reasons for not performing the test in general practice. In Australia spirometer prices vary,¹⁴ but the authors have calculated that a practice needs to test approximately 206 patients to recover the cost of purchasing a spirometer. It may be that increasing remuneration for spirometry may help to increase its use. The increased cost to insurance systems should be offset by proactive management of patients with COPD reducing hospital admissions.¹⁵

To obtain clinically useful spirometry results the operator must have specific knowledge and skills not

only to correctly operate, maintain and calibrate the instrument, but also to motivate the patient to perform the correct breathing manoeuvre.^{1,16} Even brief training increases the amount of acceptable and reproducible spirometry when compared with reliance on the spirometer manual as 'training'.¹² Similarly, the quality of spirometry in general practice can be similar to laboratory-based tests if a spirometer displaying the flow volume loop in real time and if two 2.5-h intense training sessions separated by 1 month are implemented.¹⁷ Two studies indicate the importance of spirometry training to improve quality and address the lack of confidence in use and interpretation^{12,17} found in previous studies.¹⁰ The present study suggests that spirometry training is an issue in Australia with only 40% of general practitioners receiving less than 2 h of training and 60% indicating interest in further training. It seems less likely that this is a major barrier to spirometry ownership as only 18% of practices without a spirometer identified lack of confidence in interpretation as a barrier.

The follow-up survey, which found 84% of practices that did not respond to the initial survey own a spirometer, indicates that the reported 64% ownership rate was unlikely to be biased towards practices that own a spirometer. Although the response rate to the survey was only 20%, this seems reasonable for such a survey of general practices and provides useful data.

Despite high spirometer ownership in general practice, the frequency of usage is low. Low rates of verification of accuracy and performance suggest the need for reliable, stable spirometers that do not require daily calibration checks to be available to general practitioners. Regular and more comprehensive training in spirometry is needed and would be welcomed by most general practitioners.

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REFERENCES

- 1 Ferguson GT, Enright PL, Buist S, Higgins MW. Office spirometry for lung health assessment in adults: a consensus statement from the National Lung Health Education Program. *Chest* 2000; **117**: 1146–61.
- 2 Pauwels RA, Buist AS, Calverley PM, Jenkins CR, Hurd SS on behalf of the GOLD Scientific Committee. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop summary. *Am. J. Respir. Crit. Care Med.* 2001; **163**: 1256–76.

- 3 McKenzie DK, Frith PA, Burdon JG, Town GI, Australian Lung Foundation, Thoracic Society of Australia and New Zealand. The COPDX Plan: Australian and New Zealand Guidelines for the management of Chronic Obstructive Pulmonary Disease. *Med. J. Aust.* 2003; **178**: S7–39.
- 4 Fardy J, Bellamy D, Booker R. *COPD in Primary Care: All a GP Needs to Know about Chronic Obstructive Pulmonary Disease*. McGraw-Hill Australia, Sydney, 2003.
- 5 AIHW Australian Centre for Asthma Monitoring. *Asthma in Australia 2005*. AIHW Asthma Series 2. AIHW Cat. No. ACM 6. AIHW, Canberra, 2005.
- 6 Buffels J, Degryse Heyrman J, Decramer M, DIDASCO Study. Office spirometry significantly improves early detection of COPD in general practice: the DIDASCO Study. *Chest* 2004; **125**: 1394–9.
- 7 O'Dowd LC, Fife D, Tenhave T, Panettieri RA Jr. Attitudes of physicians toward objective measures of airway function in asthma. *Am. J. Med.* 2003; **114**: 391–6.
- 8 Walters JAE, Hansen E, Mudge P, Johns DP, Walters EH, Wood-Baker R. Barriers to the use of spirometry in general practice for diagnosis and management of COPD. *Aust. Fam. Physician* 2005; **34**: 201–3.
- 9 Tryon K, Kennedy Y, Rea H. Spirometry use in general practice. *Respirology* 2004; **9** (Suppl.): O4.
- 10 Bolton CE, Ionescu AA, Edwards PH *et al.* Attaining a correct diagnosis of COPD in general practice. *Respir. Med.* 2005; **99**: 493–500.
- 11 Rudolf M, Buchanan A, Hart L, on behalf of the COPD Consortium. Making spirometry happen. *Thorax* 1999; **54** (Suppl. 3): A43.
- 12 Eaton T, Withy S, Garrett JE *et al.* Spirometry in primary care practice. The importance of quality assurance and the impact of spirometry workshops. *Chest* 1999; **116**: 416–23.
- 13 American Thoracic Society. Standardisation of spirometry: 1994 update. *Am. J. Respir. Crit. Care Med.* 1995; **152**: 1107–36.
- 14 Schermer TR, Jacobs JE, Chavannes NH *et al.* Validity of spirometric testing in a general practice population of patients with chronic obstructive pulmonary disease (COPD). *Thorax* 2003; **58**: 861–6.
- 15 Rea H, McAuley S, Stewart A, Lamont C, Roseman P, Didsbury P. A chronic disease management programme can reduce days in hospital for patients with chronic obstructive pulmonary disease. *Int. Med. J.* 2004; **34**: 608–14.
- 16 Burton DL, Johns D, Swanney M. *Spirometer Users' and Buyers' Guide*. National Asthma Council, South Melbourne, Victoria, 2005.
- 17 Schermer T, Eaton T, Pauwels C, van Weel C. Spirometry in primary care: is it good enough to face demands like World COPD Day? *Eur. Respir. J.* 2003; **22**: 725–7.

APPENDIX I

Survey Questionnaire

All information gathered in this survey will be de-identified, practice ID or name is asked for gauging practice demographic data only.

AGPAL PRACTICE ID NUMBER (if known)

PRACTICE NAME AND ADDRESS

- Q1 Does your practice own a spirometer? No ☐ Yes ☐
If yes please go to Q4
- Q2 Have you considered buying a spirometer? No ☐ Yes ☐
Please go to Q21
- Q3 For what reasons have you not brought a spirometer?
 (a) Cost ☐
 (b) Do not believe the information is useful ☐
 (c) Not confident in interpreting results ☐
 (d) Insufficient Medicare remuneration ☐
 (e) Do not have practice nurse ☐
 (f) No time to perform spirometry ☐
 (g) Other (briefly explain) ☐
 Please go to Q21

- Q4 What is the make and model of your spirometer? Make
Model
- Q5 Does your spirometer produce a permanently recorder trace? No ☐ Yes ☐
- Q6 How often is spirometry performed in your practice?
 (a) More than five times per week ☐
 (b) One to five times per week ☐
 (c) One to four times per month ☐
 (d) Less than once per month ☐

- Q7 Do you use spirometry for:
- (a) Diagnosing patients with asthma ☐
 - (b) Management of your asthma patients ☐
 - (c) Assessment of breathlessness/dyspnoea ☐
 - (d) Screening current/ex-smokers ☐
 - (e) Diagnosis and management of other respiratory diseases such as COPD ☐
 - (f) Other (briefly explain) ☐
-
-
-
- Q8 Who performs the spirometry testing in your practice?
- (a) GP ☐
 - (b) Nurse ☐
 - (c) Other (briefly explain) ☐
-
-
- Q9 How long does it take you or your staff to perform testing? (pre- and post-bronchodilator)
- (a) Less than 10 min per patient ☐
 - (b) Between 10 and 20 min per patient ☐
 - (c) More than 20 min per patient ☐
 - (d) We only do pre-bronchodilator tests ☐
- Q10 Who interprets the results?
- (a) GP ☐
 - (b) Nurse ☐
 - (c) Other (briefly explain) ☐
-
-
- Q11 What training have those persons had in the use of a spirometer and interpreting results?
- (a) NAC ☐
 - (b) RACGP ☐
 - (c) Division ☐
 - (d) Other (briefly explain) ☐
-
-
- Q12 How long was the training?
- (a) Less than 2 h ☐
 - (b) Half a day ☐
 - (c) 1–2 days ☐
 - (d) 3–5 days ☐
- Q13 What other spirometer learning resources have you used? (briefly explain)
-
-
- Q14 Would you attend a CPD accredited course on spirometry?
- (a) Definitely ☐
 - (b) Probably ☐
 - (c) Maybe ☐
 - (d) Unlikely ☐
 - (e) Definitely not ☐
- Q15 How often do you check the accuracy of your spirometer?
- (a) Daily ☐
 - (b) Weekly ☐
 - (c) Monthly ☐
 - (d) Yearly ☐
 - (e) Never ☐
- Q16 Do you use a 3-L calibration syringe to check the accuracy of your spirometer
- No ☐ Yes ☐
- Q17 Do you measure spirometry on a healthy subject to check spirometry performance?
- No ☐ Yes ☐
- If no please go to Q20

Q18 How often do you check spirometry performance?

- (a) Daily ☐
 (b) Weekly ☐
 (c) Monthly ☐

Q19 Who performs this check?

- (a) GP ☐
 (b) Nurse ☐
 (c) Other (briefly explain) ☐
-
-

Q20 What precautions do you take to minimize the risk of cross-infection between patients?

- (a) Barrier filters ☐
 (b) New or disinfected mouthpiece ☐
 (c) None ☐
 (d) Other (briefly explain) ☐
-
-

Q21 If your practice does not own a spirometer, what access do you have to spirometry services?

- (a) Mobile ☐
 (b) Hospital ☐
 (c) Local pathology service ☐
 (d) Specialist physician ☐
 (e) Other (briefly explain) ☐
-
-

Q22 For those who are serviced by a mobile service, how often would you have access to that service?

- (a) Weekly ☐
 (b) Monthly ☐
 (c) Other (briefly explain) ☐
-
-