Primary Care Respiratory Journal (2006) **15**, 286–293

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PRIMARY CARE RESPIRATORY JOURNAL

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ORIGINAL RESEARCH

The diagnostic accuracies of chronic obstructive pulmonary disease (COPD) in general practice: the results of the MAGIC (Manchester Airways Group Identifying COPD) study

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Received 11 November 2005; accepted 20 July 2006

KEYWORDS
Adults;
COPD;
Diagnosis;
General practice

Summary
Background: Although it is generally accepted that chronic obstructive pulmonary disease (COPD) is underdiagnosed, there is little objective information concerning the size of the problem in the UK.
Method: Patients from two general practices were offered spirometry if they were aged 30 or older, had reported ever smoking in one of four postal respiratory surveys (1993–2001), and/or reported four or more symptoms or risk factors in 2001 indicating likely obstructive airways disease.
Results: Of 2646 subjects invited, 871 attended and 825 had adequate spirometry results for analysis. In all, 163 patients had spirometrically-confirmed COPD; 103 of these (63.2%) had no recorded COPD in their practice records, including 14 out of 31 (45.2%) whose spirometry results classified them as having severe or very severe COPD.
Conclusion: This study found a considerable under-recording of COPD in two general practices. This may be due to a combination of administrative and diagnostic problems (including the under-use of spirometers), and a reluctance of patients to present with their symptoms. These results have important implications in terms of unmet need and resource utilisation.

Introduction

Although it is predicted that COPD will be the fifth leading cause of disability and the third leading cause of death in the world in the first half of the 21st century [1], there is no standard approach

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doi:10.1016/j.pcrj.2006.07.007

to the definition of the condition, and diagnosis by lung function testing has used varying criteria [2—5]. It is therefore not surprising that the correct identification of patients with COPD has proved difficult in general practice [6—8].

The principal aims of the MAGIC study (Manchester Airways Group Identifying COPD) were to examine the diagnosis and recording of COPD and to estimate the prevalence of the condition in two general practice populations in an area of South Manchester with high levels of deprivation [9]. This paper is concerned with the accuracy of diagnosis and the recording of COPD in the patients' general practice records.

Method

The study was part of the Wythenshawe Community Asthma Project (WYCAP), a long term investigation of the natural history of respiratory symptoms in two general practices [10—12] approved by South Manchester Local Research Ethics Committee.

Postal respiratory questionnaire surveys were carried out on four separate occasions, between 1993 and 2001. The questionnaire used for adults was based on the European Community Respiratory Health Questionnaire [13] with added questions concerning current smoking, history of hay fever/eczema, and family history of asthma. [10]. A simple scoring system was developed and found to be useful in identifying subjects with likely obstructive airways disease (OAD) [14], although it was not used to differentiate COPD from asthma. Those reporting four or more symptoms or risk factors from six key questions (wheezing, being woken by cough, being woken by chest tightness, being woken by shortness of breath — all in the previous 12 months, history of hay fever/eczema, and family history of asthma) were categorised as having OAD.

Figure 1 shows the inclusion criteria for the study. Patients were considered eligible for the present study if they

- replied to the 2001 survey and
- were aged 30 years or more at the time of the 2001 survey and
- responded in any of the four surveys that they were a current smoker and/or reported four or more of the six key symptoms or risk factors (i.e. likely to have OAD) in the 2001 survey.

Over a period of 18 months (July 2002 to December 2003) the practice nurses attempted to make contact with all eligible patients by telephone, by letter if no telephone number was available, or opportunistically if they consulted at the surgery.

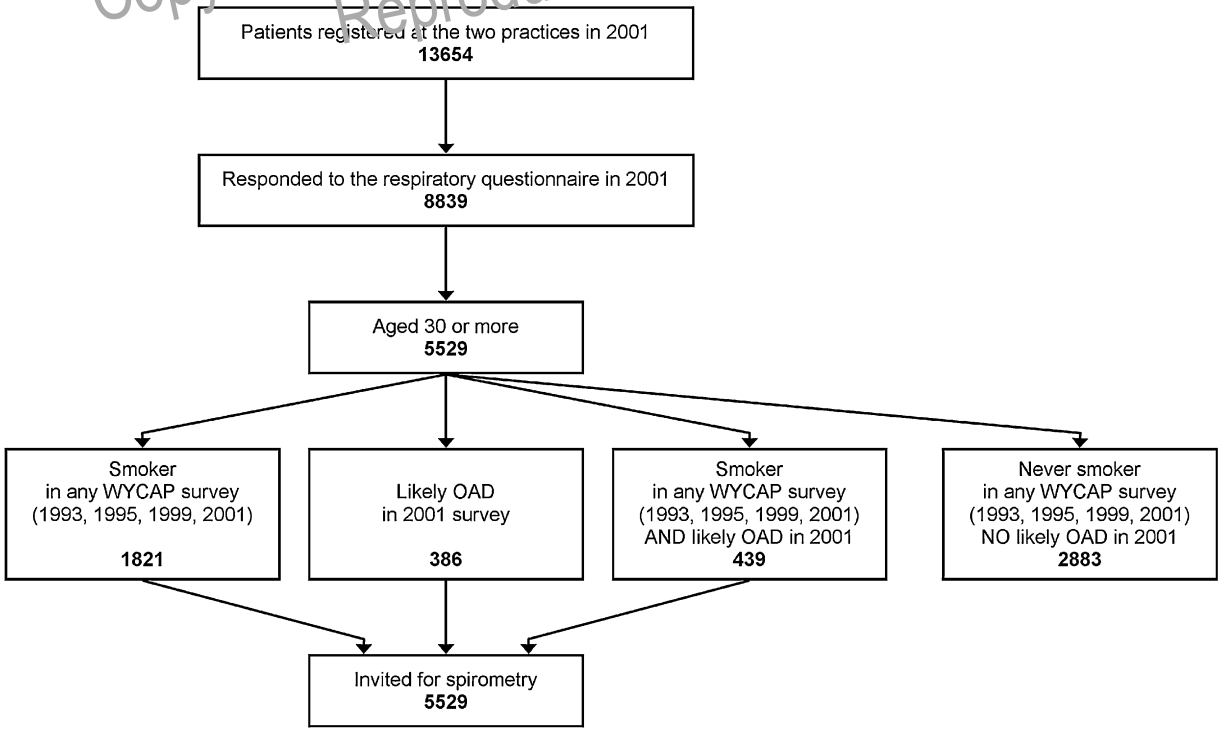

Figure 1 Inclusion criteria.

Table 1 Characteristics of those included in the analyses compared with those invited but not included due to non-response or inadequate spirometry results

	Successful spirometry $n = 825$	No spirometry $n = 1821$	Difference	95% CI of difference
Mean age (2001)	55.5	50.7	4.8	3.6 to 6.0
% female	54.7	52.9	1.8	−2.3 to 5.9
% ever smokers	65.2	74.9	−9.7	−13.5 to −5.9
% Likely OAD (2001)	37.2	31.4	5.8	1.9 to 9.7

Patients were invited to attend the surgeries for an interview and for lung function tests, at which point oral informed consent to participate was obtained. The practice nurses, all of whom had received special training in spirometry by a trained lung function technician from the North West Lung Centre, carried out interviews and measurements. As the last postal questionnaire had been completed more than one year before the present study, participants were asked to complete a new respiratory questionnaire similar to those used in the WYCAP surveys with some added questions concerning chronic cough (Appendix A). These new data were used for the present analyses.

Additional smoking history was recorded by direct questioning. Current and ex-smokers were asked about their daily consumption and the number of years they had smoked; smoking history in pack years was then calculated.

Spirometry was carried out using a MicroLoop spirometer (Micro Medical Ltd, Rochester, Kent). Forced expiratory volume in one second (FEV_1), forced vital capacity (FVC) and FEV_1/FVC ratio were measured. Reversibility testing was carried out using salbutamol 400 mcg and ipratropium bromide 80 mcg (combined preparation) via a large volume spacer, with re-testing 20 minutes after inhalation.

The definition of COPD used in this study was based on spirometry results and was in accordance with the 2003 GOLD criteria [5]. Subjects with GOLD stage 2−4 disease were classified as having COPD (FEV_1 < 80% of predicted and FEV_1/FVC ratio < 70%, after bronchodilation).

For all participants, a search was made in the practice computer records for a diagnosis of COPD (ever) or asthma (ever), and for any prescription for inhaled respiratory medications over the previous 12 months.

Differences in means and proportions are presented, along with 95% confidence intervals of those differences [15]. Trends in proportions were examined for statistical significance using the chi-squared test for trend [16].

Results

In total, 13654 patients were registered with the two practices in 2001. Response rates ranged from 76% in 1993 to 68% in 2001 [12]. For the present study, 2646 patients fulfilled the entry criteria and were invited for spirometry (Figure 1). In all, 871 (32.9%) attended for testing, of whom 825 (94.7%) had results that were adequate for analysis. Those included were older and more likely to have been categorised as having likely OAD in the 2001 survey, but had a significantly lower prevalence of 'ever' smokers (having indicated that they smoked in one of the four surveys) than the remainder of the invited patients (Table 1).

Spirometry results were consistent with a diagnosis of COPD (GOLD stage 2-4) in 163 subjects. COPD increased with age (Table 2) (chi-squared = 62.81 on 5df, p for trend <0.001) and it was more frequent in males (23.5%) than females (16.6%) (difference 6.9%, 95% confidence interval (CI) of difference 1.4 to 12.4%) (Table 3). COPD was also more frequent in those with a smoking history of more than 20 pack years.

A practice-recorded diagnosis of COPD was also more frequent in older patients (Table 2) (chi-squared = 25.04 on 5 df, p for trend < 0.001), in males, and in those with a smoking history of 20 or more pack years (Table 3). There was no mention of COPD in the practice records in 103 of the

Table 2 Number (%) of subjects with COPD by age in those with adequate spirometry

	30−39	40−49	50−59	60−69	70−79	80+	Total
Screened population	103	172	241	167	119	23	825
COPD by spirometry	1 (1.0)	20 (11.6)	38 (15.8)	54 (32.3)	44 (37.0)	6 (26.1)	163
Recorded diagnosis	1 (1.0)	7 (4.1)	12 (5.0)	19 (11.4)	17 (14.3)	4 (17.4)	60

Table 3 Number (%) of subjects with COPD in those with adequate spirometry by gender and smoking status

	Gender			Smoking status				
	Female	Male	Difference (95% CI)	Never	<20 pack years	Difference (95% CI) never smokers vs <20 pack yrs	20+ pack years	Difference (95% CI) <20 pack yrs vs 20+ pack yrs
Screened population	451	374		77	247		481	
COPD by spirometry	75 (16.6)	88 (23.5)	6.9 (1.4 to 12.4)	7 (9.1)	27 (10.9)	1.8 (−5.6 to 9.4)	126 (26.2)	15.3 (9.7 to 20.1)
Recorded diagnosis	25 (5.5)	35 (9.3)	3.8 (1.9 to 7.4)	2 (2.6)	11 (4.5)	1.9 (−2.5 to 6.2)	46 (9.6)	5.1 (1.4 to 8.8)

163 subjects (63.2%) who had a diagnosis of COPD confirmed by spirometry, although 23 did have a recorded diagnosis of asthma (Table 4).

Almost half (46%) of the individuals with confirmed COPD (GOLD stage 2—4) had no record of prescribed inhaled medication in the previous year. Even in those 60 subjects with a confirmed diagnosis and a practice-recorded diagnosis, ten (16.7%) had received no inhaled medication. Of 103 subjects with COPD confirmed by spirometry but with no recorded diagnosis, post-bronchodilator FEV_1 was less than 50% of predicted in 14 subjects, indicating severe or very severe disease.

When severity was examined according to GOLD classification (using post-bronchodilator lung function results) (Table 4), 31 of those individuals with confirmed COPD were classified as ''severe'' or ''very severe''. Almost half of these (14) had no record of COPD at their general practice.

There was also an element of over-diagnosis in this population. In 28 out of 88 patients (31.8%) who had a practice-recorded diagnosis of COPD, the spirometry results did not support this diagnosis (GOLD Stage 2—4) although 14 of these patients would be classified as GOLD stage 0 (at risk but with normal spirometry) or Gold Stage 1 ($FEV_1 \geq 80\%$ predicted and $FEV_1/FVC < 70\%$).

Discussion

This study examined the diagnosis and recording of COPD in a group of high-risk subjects selected from two general practice populations in an area with high levels of socio-economic deprivation. When the Wythenshawe Community Asthma Project commenced, Manchester had double the national average rate of unemployment, more households with dependent children but no working adults, higher proportions of partly skilled or unskilled adults, and lower levels of home and car ownership [17]. In the southern suburban wards (voting districts) of Baguley, Benchill and Woodhouse Park, where the MAGIC study took place, even higher levels of adults of working age were partly skilled or unskilled and more households received housing benefit (over half). Most adults were classified in social class IIIM (manual skilled occupations) of the UK Registrar General's classification. The situation was similar in the 1998 Local Census report [18].

The age profile of respondents to the 2001 survey was very similar to the local population estimates for wards in England in mid 1998 [19] produced by the Social Disadvantage Research Group of Oxford University. Females were likely to have been overrepresented among respondents to the

Table 4 Number of subjects by GOLD classification of COPD and recorded diagnosis in practice records in those with adequate spirometry

	GOLD stage					
	Not at risk	0 At risk	1 Mild	2 Moderate	3 Severe	4 Very severe
FEV_1 % predicted	≥80%	≥80%	≥80%	≥50% but <80%	≥30% but <50%	<30%
FEV_1/FVC	≥70%	≥70%	<70%	<70%	<70%	<70%
Chronic symptoms	yes	no	—	—	—	—
No recorded diagnosis	466	57	13	69	10	1
Asthma only	82	10	6	20	2	1
COPD only or COPD and asthma	14	9	5	43	15	2
Total	*n* = 562	*n* = 76	*n* = 24	*n* = 132	*n* = 27	*n* = 4

2001 survey compared with the population as a whole.

Spirometry results suggested that 20% of these subjects had COPD, of whom 19% would be categorised as ''severe'' or ''very severe'' by GOLD criteria [5]. 63% of the patients with spirometrically-defined COPD had no mention of the condition in their practice records; even amongst those whose spirometry showed severe or very severe disease, COPD was not recorded in 48.5% of cases.

Possible factors causing the discrepancy between spirometrically-defined COPD and the recording of the condition in these patients' general practice records could include: incorrect or non-diagnosis by the doctors; administrative failure to record the diagnosed condition correctly; a reluctance of patients to report symptoms; and the under-use of spirometry. A lack of access to spirometers prior to the study may also have affected the correct diagnosis of COPD, although this deficiency has since been corrected in these practices.

Some individuals with COPD could have been wrongly diagnosed as having asthma and will therefore be treated according to a different set of guidelines and possibly given inhaled medication without an appropriate diagnosis [20]. Distinguishing between asthma and COPD remains difficult in primary care and recent advice that reversibility testing is not routinely necessary [21] has made that task harder. Rigid spirometric criteria made it easier to fit a patient into a diagnostic label even though these labels may have been incorrect. However, the impact of this change in policy is as yet undetermined.

This study used an unconventional approach to screen people for COPD by including those who screened positively for OAD and also those who reported smoking on any of the previous four surveys. Although the questions used in the OAD screening questionnaire could possibly be more likely to pick up asthmatic patients rather than those with COPD, most patients with likely COPD should still have been identified for screening by their response to the smoking questions on the surveys between 1993 and 2001.

In the present study, 80 subjects had COPD (GOLD stage 2—4) confirmed by spirometry and no practice record of either asthma or COPD, but 17 of these had received inhaled medication in the past year. The failure to record either condition could have been due to either labelling, or diagnostic error, or both. A further 23 patients with COPD, confirmed by spirometry, had a practice record only of asthma, of whom 21 had received inhaled medication. In 14 patients there was a practice record of COPD but spirometric results were normal and the patients had no symptoms suggestive of COPD.

At the time of the study there was no universally accepted standard reversibility test or standardised dosing schedule for either salbutamol or antimuscarinic bronchodilators. The timing between dose administration and post-bronchodilator spirometry was adequate for the salbutamol dose but may not have been long enough to fully reverse bronchoconstriction in those subjects only sensitive to antimuscarinic agents. As this is uncommon, only a very small number of participants would have been affected in this way and a longer time interval may have had a wider negative impact on recruitment and cost of the study.

The unwillingness of patients to report symptoms may also have played a part in the apparent underdiagnosis of COPD in these practices, with patients accepting their symptoms as a part of ageing or being due to smoking, thus making them less likely to report symptoms to their doctor. This is supported by the relatively low response rate to

the invitation to participate. Less than one third of those invited actually attended for spirometry and the possibility of selection bias must be considered. There were significantly more attenders than non-attenders with likely OAD which would tend to overestimate the prevalence of COPD—although more non-attenders than attenders smoked, which would lead to an underestimate. It is possible that the same factors lead to both a reluctance to report symptoms and a reluctance to participate in research regarding respiratory health.

The study was carried out in only two practice populations in one area in Manchester and may not be representative of the UK as a whole, although it is likely to represent areas with similar socio-economic profiles. Comparison of these results with other reported studies is difficult due to wide variations in methods, definitions and populations sampled [22]. Although it is generally agreed that COPD is underdiagnosed and that perhaps only 25—50% of patients with the condition are known to their doctors [2,8,23,24], little objective quantification has been undertaken and no figures from British general practice have been published. The present results show that their doctors knew about only 36.8% of subjects with a spirometric diagnosis of COPD, a similar proportion to a recent Swedish study [25].

The under-recording of COPD identified in this study could have important implications in terms of missing opportunities to offer smoking cessation advice, with all the attendant morbidity, mortality and health care resource implications that this may have. The patients whose diagnoses have not been correctly recorded may also miss the opportunity to receive regular review of symptoms and therapy which may affect not only their symptoms but also their health-related quality of life.

The new UK General Practice GMS2 contract encourages correct diagnosis and follow-up of COPD by rewarding spirometry with investment. It remains to be seen if this system will help solve the problems of under-recording of COPD and access to spirometry.

Conclusion

There was an under-recording of COPD in these two practices. Whether this was due to under-reporting by patients, lack of (or faulty) diagnosis by the doctor, or administrative recording problems, it has important implications in terms of unmet need and utilisation of resources. It remains to be determined whether the recently introduced quality targets for diagnosing COPD in UK primary care will improve the situation.

Confict of interests

TF has received fees from GSK, Boehringer Ingelheim, Schering Plough and Astra Zeneca for speaking, funds for research from GSK, Boehringer Ingelheim, MSD and Schering Plough, funds for consultancy from GSK and Pharmacia and travel grants from GSK, Boehringer Ingelheim, Astra Zeneca, Chiesi Pharmaceuticals and MSD.

MH has received a fee from Boehringer Ingelheim for speaking and travel grants from GSK, Boehringer Ingelheim and MSD.

ML has received travel grants from GSK.

PF has received fees for attending symposia from GSK and MSD, funds for research from GSK, Boehringer Ingelheim and MSD and travel grants from GSK, Boehringer Ingelheim and MSD.

Acknowledgments

Funding: This study was funded by an unconditional grant from Boehringer Ingelheim.

Ethical Approval: South Manchester Local Research Ethics Committee approved this study.

Appendix A

Please tick the appropriate box

1. What is your date of birth? ☐
2. Are you — FEMALE ☐ MALE ☐
3. Have you had wheezing or whistling in your chest at any time **in the last 12 months?** — NO ☐ YES ☐
   IF 'NO' GO TO QUESTION 4,
   IF 'YES':
   - 3.1 Have you been at all breathless when the wheezing noise was present? — NO ☐ YES ☐
   - 3.2 Have you had this wheezing or whistling when you did not have a cold? — NO ☐ YES ☐
4. Have you woken up with a feeling of tightness in your chest **in the last 12 months?** — NO ☐ YES ☐
5. Have you been woken by an attach of shortness of breath at any time **in the last 12 months?** — NO ☐ YES ☐
6. Have you woken by an attack of coughing at any time **in the last 12 months?** — NO ☐ YES ☐
7. Have you had an attack of asthma **in the last 12 months?** — NO ☐ YES ☐
8. Are you currently taking any medicine for asthma? (including inhalers, aerosols or tablets) — NO ☐ YES ☐
9. Has any person in your family (parents, grandparents, sisters, brothers or your children) had asthma? — NO ☐ YES ☐
10. Have you ever had hay fever or eczema? — NO ☐ YES ☐
11. How many cigarettes do you smoke each day? ☐ Per day
12a. How many other adults live in your house? ☐
12b. How many of these adults smoke? ☐
13. Do you usually cough **first thing in the morning** in the winter? — NO ☐ YES ☐
14. Do you usually cough **during the day, or at night**, in the winter? — NO ☐ YES ☐
    IF 'NO' GO TO QUESTION 15,
    IF 'YES':
    - 14.1 Do you cough like this on most days for as much as three months each year? — NO ☐ YES ☐
15. Do you usually bring up any phlegm from your chest **first thing in the morning**, in the winter? — NO ☐ YES ☐
16. Do you usually bring up any phlegm from your chest **during the day, or at night** in the winter? — NO ☐ YES ☐
    IF 'NO' GO TO QUESTION 15,
    IF 'YES':
    - 16.1 Do you bring up phlegm like this on most days for as much as three months each year? — NO ☐ YES ☐

NOW PLEASE TURN OVER AND COMPLETE THE QUESTIONS ON YOUR OWN HEALTH TODAY

References

[1] Murray CJ, Lopez AD. Mortality by cause for eight regions of the world: Global Burden of Disease Study. Lancet 1997;349(9061):1269—76.

[2] van den Boom G, van Schayck CP, van Mollen MP, et al. Active detection of chronic obstructive pulmonary disease and asthma in the general population. Results and economic consequences of the DIMCA program. Am J Respir Crit Care Med 1998;158(6):1730—8.

[3] European Respiratory Society: COPD [http://www.ersnet.org/ers/viewer_copd/mainFrame/default.aspx].

[4] American Thoracic Society: COPD [http://www.thoracic.org/COPD/1/points.asp].

[5] National Heart Lung and Blood Institute, World Health Organisation: Global Initiative for Chronic Obstructive Lung Disease (GOLD) (2003). Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease [http://goldcopd.com/download.asp?intId=231].

[6] van Weel C. Underdiagnosis of asthma and COPD: is the general practitioner to blame? Monaldi Arch Chest Dis 2002;57(1):65—8.

[7] Pena VS, Miravitlles M, Gabriel R, et al. Geographic variations in prevalence and underdiagnosis of COPD: results of the IBERPOC multicentre epidemiological study. Chest 2000;118(4):981—9.

[8] Takahashi T, Ichinose M, Inoue H, Shirato K, Hattori T, Takishima T. Underdiagnosis and undertreatment of COPD in primary care settings. Respirology 2003;8(4):504—8.

[9] Manchester Health for All Working Party. In: Stevens R, editor. Health Inequalities and Manchester in the 1990's Manchester: Manchester Health for All Working Party; 1993. pp. 14.

[10] Frank P, Ferry S, Moorhead T, Hannaford P. Use of a postal questionnaire to estimate the likely underdiagnosis of asthma-like illness in adults. Br J Gen Pract 1996;46(406):295—7.

[11] Frank PI, Morris JA, Frank TL, Hazell ML, Hirsch S. Trends in smoking habits: a longitudinal population study. Fam Pract 2004;21(1):33—8.

[12] Frank PI, Wicks PD, Hazell ML, et al. Temporal change in the prevalence of respiratory symptoms and obstructive airways disease 1993—2001. Br J Gen Pract 2005;55(517):596—602.

[13] Burney PG, Luczynska C, Chinn S, Jarvis D. The European Community Respiratory Health Survey. Eur Respir J 1994;7(5):954—60.

[14] Frank TL, Frank PI, Cropper JA, et al. Identification of adults with symptoms suggestive of obstructive airways disease: validation of a postal respiratory questionnaire. BMC Family Practice 2003;4(5).

[15] Gardner MJ, Altman DG. Confidence intervals rather than P values: estimation rather than hypothesis testing. Br Med J (Clin Res Ed) 1986;292(6522):746—50.

[16] Armitage P. Tests for linear trends in proportions and frequencies. Biometrics 1955;11(3):375—652.

[17] Butler D, Frost L, Morris J, Spence M, Stevens R, Young A. Health Inequalities and Manchester in the 1990s. Manchester: Manchester Health For All Working Party; 1993.

[18] Department of Planning Studies. 1998 Local Census Ward Comparison. Manchester: Manchester City Council; 2000.

[19] Office of National Statistics: Neighbourhood Statistics [http://www.statistics.gov.uk/neighbourhood/metadata.asp?dsno=21].

[20] Lindstrom M, Jonsson E, Larsson K, Lundback B. Underdiagnosis of chronic obstructive pulmonary disease in Northern Sweden. Int J Tuberc Lung Dis 2002;6(1):76—84.

[21] National Collaborating Centre for Chronic Conditions. Chronic obstructive pulmonary disease. National clinical guideline on management of chronic obstructive pulmonary disease in adults in primary and secondary care. Thorax 2004;59(Suppl 1):1—232.

[22] Halbert RJ, Isonaka S, George D, Iqbal A. Interpreting COPD prevalence estimates: what is the true burden of disease? Chest 2003;123(5):1684—92.

[23] Van Schayck CP, Chavannes NH. Detection of asthma and chronic obstructive pulmonary disease in primary care. Eur Respir J 2003;39(Supplement):16s—22s.

[24] McIvor RA, Tashkin DP. Underdiagnosis of chronic obstructive pulmonary disease: a rationale for spirometry as a screening tool. Can Respir J 2001;8(3):153—8.

[25] Lundbäck B, Lindberg A, Lindstrom M, et al. Obstructive Lung Disease in Northern Sweden S: Not 15 but 50% of smokers develop COPD?—Report from the Obstructive Lung Disease in Northern Sweden Studies. Respir Med 2003;97(2):115—22.