

PostScript

LETTERS TO THE EDITOR

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Compliance and reliability of electronic PEF monitoring in adolescents with asthma

Self-management education is the cornerstone of modern asthma care and consists of self-monitoring, transfer of information, a written action plan, and regular medical review.¹ Current international guidelines recommend the use of home monitoring of peak expiratory flow (PEF) as a part of self-monitoring.² PEF recordings potentially provide valuable information on risk prediction of asthma episodes and effectiveness of treatment.³ However, compliance and reliability of written PEF diaries is poor.⁴

Information and communication technologies (ICT) such as the internet and mobile phone short message service (SMS) are potentially powerful tools in the management of asthma. The use of these technologies enables adolescents to fit asthma management into their daily life activities. We therefore investigated the compliance and reliability of daily PEF measurements by adolescents with controlled and uncontrolled asthma symptoms using a handheld electronic spirometer and reporting the data via the internet or SMS.

Ninety seven adolescents aged 12-17 years with physician diagnosed asthma and regular prescriptions of low or medium dose inhaled corticosteroids for at least 3 months in the previous year were recruited from general practices and from the outpatient clinic of the department of paediatrics. Patients using systemic steroids, having no access to the internet, and those with serious co-morbidities were excluded. Participants and their parents gave written informed consent and the study was approved by the medical ethics committee of the Leiden University Medical Center, Leiden, the Netherlands.

All participants received an electronic spirometer (PiKo1; Ferraris, UK) and were trained to perform a forced expiratory manoeuvre. They were asked to perform three manoeuvres every morning before taking medication and to report PEF values by typing these daily on a designated web application or via SMS for 4 weeks. Participants instantly received a receipt message with the PEF value

expressed as a percentage of their personal best value. They were unaware that the spirometer also stored the values in a memory chip. The participants completed the Asthma Control Questionnaire (ACQ) weekly.⁵

Reported compliance was defined as the proportion of reported PEF entries to the number of expected entries. Actual compliance was calculated as the proportion of entries in the spirometer memory to the number of expected entries. In order to evaluate reliability, the reported PEF values were compared with the spirometer memory: correctly reported values were identical to the spirometer memory values on the same day. We distinguished between controlled and uncontrolled asthma symptoms on the basis of the mean ACQ score over 4 weeks, a score of ≤ 0.5 indicating controlled asthma and a score of > 0.5 indicating uncontrolled asthma. Repeated measures analysis of variance was used to assess differences between the 4 weeks and between the two ACQ groups.

Mean (SD) PEF values were 419 (97) l/min and 378 (86) l/min for the controlled and uncontrolled groups, respectively ($p = 0.052$). Overall reported compliance was 90.6% and actual compliance was 91.5%. Actual compliance significantly decreased between week 1 (97.2%) and week 4 (83.7%; $p < 0.01$, ANOVA). Correctly reported PEF values were found on 79.2% of the days; 2.2% of the PEF values were self-invented (table 1). There were no differences between ACQ groups.

We conclude that the compliance and reliability of home PEF measurements by adolescents using the internet or SMS is high over a 4 week period. Actual compliance was over 83% during the whole period. Compared with conventional written diary cards, electronic monitoring and reporting seems to result in better compliance and reliability.⁴ The internet and SMS are both well established communication tools in the daily lives of adolescents, and this probably accounts for these remarkably good results. We observed a

modest decline in compliance and an increase in erroneous reports over time which had not reached a plateau by week 4. The feasibility of long term ICT based monitoring by adolescents is therefore uncertain. In our observational study lung function monitoring was not followed by feedback and/or therapeutic consequences which might have negatively influenced compliance over time. Implementation of electronic monitoring into an asthma management programme in adults has shown continuing high compliance rates.⁶ This study supports the implementation and evaluation of electronic PEF monitoring as part of ICT based asthma management programmes in adolescents.

V van der Meer

Departments of Medical Decision Making and Public Health and Primary Care, Leiden University Medical Center, Leiden, The Netherlands

E R V M Rijkers-Mutsaerts

Department of Paediatrics, Leiden University Medical Center, Leiden, The Netherlands

P J Sterk

Department of Pulmonology, Leiden University Medical Center, Leiden, The Netherlands

H A Thiadens, W J J Assendelft

Department of Public Health and Primary Care, Leiden University Medical Center, Leiden, The Netherlands

J K Sont

Department of Medical Decision Making, Leiden University Medical Center, Leiden, The Netherlands

Correspondence to: Mr V van der Meer, Department of Medical Decision Making, J10-87, Leiden University Medical Center, P O Box 9600, NL-2300 RC Leiden, The Netherlands; V.van_der_Meer@lumc.nl

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Table 1 Reliability of PEF values: mean (SD) percentages of correct, incorrect, self-invented, and missing values for patients with controlled and uncontrolled asthma symptoms

	Week 1	Week 2	Week 3	Week 4
Patients with controlled asthma symptoms (n=25)*				
Correct (%)	93.1 (13.1)	89.7 (14.6)	81.1 (25.0)	67.4 (30.2)
Incorrect (%)	4.0 (9.7)	8.0 (13.7)	9.1 (15.4)	16.0 (24.2)
Self-invented (%)	0.0 (0.0)	0.6 (2.9)	2.9 (7.1)	4.6 (9.0)
Missing (%)	2.9 (7.1)	1.7 (6.3)	6.9 (14.9)	12.0 (17.3)
Patients with uncontrolled asthma symptoms (n=72)†				
Correct (%)	86.1 (18.4)	82.1 (21.3)	76.8 (24.4)	69.2 (29.1)
Incorrect (%)	7.5 (12.5)	7.9 (13.3)	9.3 (14.2)	10.1 (12.3)
Self-invented (%)	1.2 (5.7)	1.2 (4.0)	2.0 (5.5)	4.0 (11.3)
Missing (%)	5.2 (11.3)	8.7 (15.5)	11.9 (20.9)	16.7 (26.5)

*Mean (SD) Asthma Control Questionnaire (ACQ) score 0.28 (0.15).

†Mean (SD) Asthma Control Questionnaire (ACQ) score 1.17 (0.56).

Correct, reported PEF values that were identical to memory values on the same day as % of expected entries; incorrect, reported PEF values that differed from memory values on the same day; self-invented, reported PEF values without a memory value on the same day; missing, expected entries where there was no PEF value reported.

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Bronchiectasis and non-tuberculous mycobacterial pulmonary infection

We read with great interest the paper by Wickremasinghe *et al* on the prevalence of non-tuberculous mycobacteria (NTM) in patients with bronchiectasis.¹ They showed that the prevalence of NTM was uncommon (only 2%) both in 50 newly referred patients and 50 follow up patients. However, the authors stated in the Discussion that “it is now our practice to screen our patients routinely once a year” because a large number of NTM isolates (28%) were detected by routine surveillance in their retrospective analysis of 71 patients with NTM sputum isolates.¹

NTM pulmonary infection associated with bronchiectasis is increasing worldwide.² However, should routine periodic screening for NTM infection be necessary for all adult patients with bronchiectasis? Is sputum culture a sufficiently sensitive method to exclude active NTM infection? Are negative sputum studies sufficient to dissuade one from the diagnosis of active NTM infection?

Bronchiectasis in general can manifest in one of two forms: as a local or focal obstructive process of a lobe or segment of a lung or as a diffuse process involving most of the lungs.³ In patients with diffuse bronchiectasis the disease is more likely to be associated with specific causes such as infection (NTM infection, *Aspergillus* infection), congenital conditions (primary ciliary dyskinesia, cystic fibrosis), or immunodeficiency.³

High resolution computed tomography (HRCT) has proved to be a reliable and non-invasive method for the diagnosis of bronchiectasis. The pattern and distribution of abnormalities revealed by HRCT scanning are influenced by the underlying cause of bronchiectasis. Multiple small nodules (and sometimes cavity or cavities) combined with diffuse (or widespread) bronchiectasis are reported to be the typical HRCT findings of NTM pulmonary infection associated with bronchiectasis,^{4–6} which was also suggested by Wickremasinghe *et al*.¹ In patients with these characteristic HRCT findings, 34–50% of patients have active NTM pulmonary infection, especially *Mycobacterium avium* complex infection.^{4–6} These abnormalities are usually confined to, or most severe in, the right middle lobe and the lingular segment of the left upper lobe in NTM pulmonary infection. This presentation is therefore now

referred to as “nodular bronchiectatic disease”.² Multiple small nodules around ectatic bronchi on the HRCT scan have been reported to represent peribronchial granuloma and caseous material.^{4–5}

The diagnosis of this type of NTM pulmonary infection is often delayed because symptoms are mild and excretion of NTM in sputum is intermittent with few colonies retrievable in culture. Many patients therefore require bronchoscopic examination or lung biopsy for diagnosis of NTM pulmonary disease.⁷ In clinical practice, HRCT scans should therefore be performed in patients with suspected bronchiectasis. NTM pulmonary infection could be suspected in selected patients who have multiple pulmonary nodules combined with diffuse bronchiectasis on the HRCT scan. Multiple sputum specimens should be examined in these patients. However, the poor sensitivity of sputum cultures suggests that, in situations where multiple sputum cultures are non-diagnostic, bronchoscopy should be performed to adequately exclude or diagnose NTM pulmonary disease.

We consider that there is no clear evidence to support the routine surveillance for NTM infection in all adult patients with bronchiectasis.

W-J Koh, O J Kwon

Division of Pulmonary and Critical Care Medicine, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Correspondence to: Dr W-J Koh, Division of Pulmonary and Critical Care Medicine, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, 50 Irwon-dong, Gangnam-gu, Seoul, 135-710, Republic of Korea; wjkoh@smc.samsung.co.kr

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Authors' reply

We would agree with much of the content of the interesting letter from Drs Koh and Kwon, particularly the details of

Mycobacterium avium complex infection and the use of CT scans in making the diagnosis.¹ We have also had experience of bronchoscopy and biopsy being necessary to make the diagnosis in some cases with suggestive radiology. The one point on which we disagree is the value of routine annual screening of sputum for acid fast bacilli, and our practice of sending three samples in all patients with a deterioration in their clinical condition which is not explained or not reversed by usual treatment.

The value of this practice will require a large prospective study with cost-benefit analysis and attention paid to false negative results. However, we would argue in favour of this approach for the following reasons. Most patients have a CT scan when bronchiectasis is first suspected. Our study² has shown that these patients may (rarely) in the future contract NTM infection which adversely affects their condition.

As Drs Koh and Kwon state, this may be insidious and go unsuspected for long periods. In our study² most patients with infection (rather than colonisation) had a heavy bacterial load (smear positive) which would make it likely that routine screening would detect the patient. Repeat CT scans in all cases that might raise suspicion of NTM is impractical. Lastly, about 50% of cases with diffuse bronchiectasis remain idiopathic even after full investigation,³ and our understanding of the pathogenesis of NTM infection is just beginning to increase. The data produced from closely studying NTM in our population of bronchiectatic patients may provide useful information in the future.

R Wilson, M Wickremasinghe, L J Ozerovitch, G Davies, T Wodehouse, M V Chadwick, S Abdallah, P Shah

Host Defence Unit, Royal Brompton Hospital, London, UK

Correspondence to: Dr R Wilson, Host Defence Unit, Royal Brompton Hospital, London SW3 6NP, UK; r.wilson@rbh.nthames.nhs.uk

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CORRECTION

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The paper entitled “Anticholinergics in the treatment of children and adults with acute asthma: a systematic review with meta-analysis” by G J Rodrigo and J A Castro-Rodriguez (10.1136/thx.2005.040444) has been published previously on 17 June 2005 as a Thorax Online First article but under the incorrect DOI (10.1136/thx.2005.047803). The publishers apologise for this error. The definitive version of the article can be found at the following citation: *Thorax* 2005;**60**:740–6.