

**Asthma patients with low perceived burden of illness: a challenge for guideline adherence**

Journal:	<i>European Respiratory Journal</i>
Manuscript ID:	draft
Manuscript Type:	Original Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Schneider, Antonius; University of Heidelberg, Department of General Practice and Health Services Research Biesecker, Kathrin; University of Heidelberg, Department of General Practice and Health Services Research Quinzler, Renate; University of Heidelberg, Department of Clinical Pharmacology and Pharmacoepidemiology Kaufmann-Kolle, Petra; AQUA-Institute Meyer, Franz Joachim; University of Heidelberg, Department of Cardiology, Angiology and Pneumology Wensing, Michel; University of Heidelberg, Department of General Practice and Health Services Research Szecsenyi, Joachim; University of Heidelberg, Department of General Practice and Health Services Research
Key Words:	asthma patients, Asthma Quality of Life, asthma severity, asthma treatment, guidelines, general practice

## Asthma patients with low perceived burden of illness: a challenge for guideline adherence

Antonius Schneider, MD, Senior Researcher<sup>1</sup>

Kathrin Biessecker, Research Assistant<sup>1</sup>

Renate Quinzler, Research Assistant<sup>2</sup>

Petra Kaufmann-Kolle, PhD, Senior Researcher<sup>3</sup>

Franz Joachim Meyer, MD, Senior Researcher<sup>4</sup>

Michel Wensing, PhD, Senior Researcher<sup>1</sup>

Joachim Szecsenyi, MD, Prof., Head of the Department and AQUA-Institute<sup>1,3</sup>

1 Department of General Practice and Health Services Research, University Hospital, University of Heidelberg

2 Department of Clinical Pharmacology and Pharmacoepidemiology, Medical Clinic and Policlinic, University Hospital of Heidelberg

3 AQUA-Institute, Göttingen

4 Department of Cardiology, Angiology and Pneumology, Medical Clinic and Policlinic, University Hospital of Heidelberg

Corresponding author: Antonius Schneider

Department of General Practice and Health Services Research, University Hospital

University of Heidelberg, Vossstrasse 2, 69115 Heidelberg, Germany

Tel. 0049-6221-564819

Fax. 0049-6221-561972

Email: [antonius.schneider@med.uni-heidelberg.de](mailto:antonius.schneider@med.uni-heidelberg.de)

Word count abstract: 199

Word count manuscript (without abstract): 2905

**Short title:** Difficult asthma patients in general practice

## Abstract

The reason why many patients seem to tolerate suffering from suboptimal treated asthma remains unclear. The aim of this survey was to evaluate the guideline adherence combined with quality of life of patients with moderate to severe asthma. In this cross sectional survey, 256 asthma patients from 43 primary care practices in Saxony-Anhalt filled in a questionnaire including the Asthma Quality of Life Questionnaire (AQLQ), the Patient Health Questionnaire (PHQ-D) and questions evaluating the asthma severity, medication and self-management. 43.4% suffered from moderate to severe asthma. Drug treatment accorded to guidelines in 36.9%, drug dosage of inhaled steroids was too low in 34.3%, 21.5% were not treated according to guidelines. 7.3% of the patients received end-of-dose therapy. AQLQ declined and depression rose with guideline non-adherence and asthma severity ( $p < 0.001$ ). Only 29.1% received asthma education. However, 64.5% of the patients without education did not want to receive education. They had a higher quality of life, lower depression ( $p < 0.001$ ) and lower use of steroids ( $p = 0.016$ ). In conclusion, the perceived burden of illness plays a more important role for education and self-management than the real severity of disease. Therefore, target-oriented interventions are needed to identify and motivate patients at risk for treatment adherence.

**Keywords:** asthma, general practice, guideline adherence, quality of life, self-management, education

## Introduction

The impact of asthma for the management in general practice is increasing due to the rising incidence of obstructive airway diseases. Detailed and widely disseminated guidelines recommend concordantly the most important aspects of medication [1,2] and patients' management such as education and self-management [3,4]. However, there seems to be a 'performance gap' between existing evidence and common practice. A large analysis of routine prescribing data proposed an under-treatment of asthma for the German health care system [5]. Analyses of such data could indeed lead to a false estimation as the real situation is possibly not reflected with them. E.g. it is not possible to detect patients with obstructive airway diseases exactly by the use of tracer medication in German general practices [6] and performed diagnostic tests are not available with routine data, thus leading possibly to under-estimation of quality of care [7]. Indeed two studies using telephone surveys also indicate that a large number of patients might be under-treated [8,9], and additionally the AIRE study highlights the low self-awareness of the patients concerning their asthma severity. As a consequence, there is a need to clarify the reasons for these deficits so that care can be improved target-orientated. The aim of the study was to evaluate the degree of guideline adherence and health related quality of life of patients with moderate and severe asthma in order to enable the development of target-oriented interventions in primary care.

## Patients and methods

### Study design

This cross-sectional questionnaire survey was performed in the Saxony-Anhalt with patients of 46 general practitioners (GPs) in 43 practices. This high proportion of single-handed practices is typical for the region. All GPs had participated in quality circles on rational prescribing in advance [10].

### Setting and patients

The GPs were asked to hand out a questionnaire to every patient with asthma coming for consultation between May and July 2005. The participating general practices are embedded in a quality improvement project, which is financed by the Ministry of Health and Social Security. The aim of this project is to evaluate the effectiveness of open benchmarking and exchange of information on best practice in quality circles regarding the management of asthma in primary care. The effectiveness will be measured with routine prescribing data as primary outcome measure and with aspects of patients' management as secondary outcome measure. In the beginning of this study, 96 GPs in 88 general practices, collaborating in this project, were asked to participate in the questionnaire survey. As there was a high work load due to the implementation of a new fee for service structure during the study period, only 43 practices agreed on handing out the questionnaire.

The GPs were instructed by a leaflet to select patients with asthma as accurately as possible. The most relevant criteria to distinguish between asthma and COPD were explained in this leaflet. For example the GPs were instructed to preferably select patients with varying symptoms, attacks of dyspnea and wheezing or with known allergy. They should avoid including heavy smokers likely to have COPD.

The patients were asked to fill in the questionnaire and to send it to the study centre, assuring the anonymous handling of their data. 3 x 250,- were raffled as an incentive for participation. The study was approved by the Medical Ethics Committee of the Medical Faculty of the University of Heidelberg.

### Measures

The patients filled in the questionnaire to determine their health related quality of life with the standardized German version of the 'Asthma Quality of Life Questionnaire' (AQLQ) and the 'Patients Health Questionnaire' (PHQ-D). The AQLQ, which has strong measurement properties (intraclass correlation 0.96), has 32 items on a seven-point scale and measures four dimensions of health related quality of life (QoL), namely activities, symptoms, emotions, environment. In addition these four dimensions are summarised to an overall score [11]. The range of the dimensions and sum score is 1 (worst) to 7 (best), the minimal important change is 0.5 [12]. The AQLQ measures were shown to be related with the clinical status in asthma [13]. Depression was assessed by the PHQ-D, which diagnoses psychological disorders using the diagnostic criteria from the DSM-IV [14]. It has nine items which can be summarised for comparing patient groups or performing longitudinal analysis. The range is 0 (best) to 27 (worst).

The patients were asked about their daily and nocturnal symptoms related to asthma, according to the international levels of asthma severity step one to four [15]. Actual

1  
2  
3 medication including dosage was documented in a structured register. Additionally,  
4 the patients were questioned on various aspects of self-management. In detail, we  
5 wanted to know, if he or she (a) had already participated in an education programme  
6 on asthma; (b) wanted to receive education; (c) had a peak flow meter at home; (d)  
7 uses a peak flow meter regularly to monitor the disease; (e) had a personal emergency  
8 plan; (f) had been admitted to hospital within the last 12 months because of asthma  
9 (g) had received unscheduled home visits by the GP or ambulatory care because of  
10 asthma within the last 12 months.  
11  
12

### 13 14 15 **Analysis**

16 The questionnaires were scanned and the data was imported automatically into SPSS  
17 11.0. by Eyes & Hands<sup>®</sup> Forms, Version 5. The plausibility was checked manually.  
18 For adherence on guidelines the medication was checked manually for each patient  
19 [15].  
20

21 Full adherence to guidelines implied that the prescribed medication was consistent  
22 with the guidelines and that the patient was in asthma step one or two at day and  
23 night. Under-dosing of medication implied that the patient received appropriate  
24 medication, but the patient rated himself in asthma step three or four at day or night.  
25 Inappropriate prescribing of medication implied that the patient was not treated  
26 according to guidelines. E.g. if only sympathomimetics were given without steroids in  
27 step 2, 3 or 4.  
28

29 As the depression scale is distributed continuously, quartiles of depression were  
30 generated to compare with the four steps of asthma severity. Quartiles of the AQLQ  
31 scales were generated to compare the QoL between the four asthma steps.  
32

33 Baseline data were presented descriptively. First of all , groups defined by guideline  
34 adherence were compared regarding depression and quality of life with analysis of  
35 variance (ANOVA). In a second step , multivariate logistic regression (inclusion  
36 model) was used to examine the associations between self-management,  
37 hospitalisation, unscheduled visits and the wish to receive education on the one hand  
38 and depression and asthma severity on the other hand. Statistical analysis was done  
39 with SPSS 11.0 for Windows. Level of significance was  $\alpha = 0.05$ .  
40  
41  
42

## 43 44 **Results**

### 45 46 **Baseline characteristics and severity of asthma**

47 314 patients received the questionnaire of whom 195 (62.1%) were female, the  
48 average age was 56.75 years. 256 (81.5%) patients sent back the questionnaire. 158  
49 (61.7%) of the responders were female, the average age was 56.27 (sd 16.39) years.  
50 Nearly half of the patients reported symptoms according to asthma step three or four  
51 due to daily symptoms. The distribution was more adverse for the daily than for  
52 symptoms at night. The health related quality of life declined with the increasing  
53 asthma severity whereas the depression rose ( $p < 0.001$  in both) (Table 1). There was  
54 no significant relation between asthma severity and age.  
55  
56  
57

58  
59  
60

Table 1
---------

### Guideline adherence and quality of life

Full adherence to guidelines was found in 86 (36.9%) patients (table 2). 29 patients in step one received a fixed combination inhaler containing a glucocorticosteroid and a long-acting  $\beta_2$ -agonist, 14 patients received an inhaled steroid. The rest used only short-acting  $\beta_2$ -agonist. Exception of full adherence were two patients in step 1 and three patients in step 2 received tiotropium bromide (5x) and ipratropium bromide (1x).

80 (34.3%) patients were treated according to the guidelines however the dosage was too low. E.g. they received low dose inhaled steroids or no theophylline despite severe symptoms. These patients reported symptoms at day according to asthma step 3 or 4. 10 (4.3%) patients in this group with asthma step 2 at day had symptoms of asthma step 3 at night. Additional medication was tiotropium bromide (9x) and theophylline (30x).

17 (7.3%) patients received medication including oral and inhaled steroids. However, they reported symptoms according to step 3 and 4. In addition they had short-acting  $\beta_2$ -agonist (8x), long-acting  $\beta_2$ -agonist (5x), theophylline (14x), montelukast (3x). The only exception of full adherence is that they received tiotropium bromide (8x), ipratropium bromide (5x) and a fixed combination of cromone and long-acting  $\beta_2$ -agonist (2x).

26 (11.2%) patients received therapy not recommended by the guidelines and reported symptoms according to step 1 or 2. None of these patients received any inhaled steroids. Instead, they were provided with tiotropium bromide (2x), ipratropium bromide (5x), theophylline (13x), a fixed combination of cromone and long-acting  $\beta_2$ -agonist (6x); in step 2 additionally short-acting  $\beta_2$ -agonist (5x) and long-acting  $\beta_2$ -agonist (8x).

24 (10.3) patients with incorrect therapy reported symptoms according to step 3 or 4. These patients also received no steroids. They received tiotropium bromide (3x), ipratropium bromide (5x), theophylline (10x), montelukast (1x), a fixed combination of cromone and long-acting  $\beta_2$ -agonist (2x). One patient received oral steroids but no inhaled steroids.

The quality of life and depression scores were associated with the asthma severity. Patients with asthma step 1 or 2 had the highest QoL (mean of AQLQ sum 5.19) and the lowest depression scores (mean 4.45). Remarkably, patients in step 3 or 4, who were treated falsely had higher QoL (4.34) and lower depression (6.30) scores than those were under-treated in step 2, 3 or 4 (3.75 and 7.89). QoL (3.01) and depression (9.06) were worst in patients with end-of-dose-treatment. The differences were significant in all categories (ANOVA).

Table 2
---------

### Impact of education and self-management

Only 26.9% of the patients participated in an educational programme for asthma with no significant difference between the groups (table 3). Only 16.9% of the patients had a peak flow meter at home, and only 4.3% used an asthma diary for protocol. The situation was similar for the usage of a personal emergency plan. There were no significant differences between the asthma level groups ( $\chi^2$ -Test). Remarkably,

patients who participated in education and those using tools for self-management had higher depression and lower QoL scores (t-Test).

Table 3

The binary logistic regression (inclusion model with analysis of interaction) revealed that the participation in education was associated with higher depression scores independent of the asthma severity ( $p = 0.004$ ; OR 1.48; 95% CI 1.13 to 1.92 for each quartile of PHQ-D). This was the same for the usage of a peak flow meter ( $p = 0.018$ ; OR 1.46; 95% CI 1.07 to 2.00) and for the usage of an asthma diary ( $p = 0.032$ ; OR 2.25; 95% CI 1.07 to 4.73). There were no relations between the use of a personal emergency plan, depression and asthma severity.

Patients who did not want to receive further education had higher QoL and lower depression scores (table 4). This effect was most apparent in patients with asthma step 3 ( $p = 0.006$ , t-Test). In addition, these patients used significantly less steroids ( $p = 0.016$ ,  $\chi^2$ -Test). It seems that more smokers are in this group. However, this effect was not significant.

Table 4

### Hospital stay and unscheduled ambulatory care

14 (5.5%) patients have been at hospital with an average length of stay of 19.1 days because of asthma within the last twelve months (table 3). There was no significant difference between the asthma level groups ( $\chi^2$ -Test). The binary logistic regression revealed a significant relation between hospitalisation and depression irrespective of asthma severity ( $p = 0.002$ ; OR 3.29; 95% CI 1.57 to 6.87 for each quartile of PHQ). 34 (13.3%) patients received emergency home visits or unscheduled ambulatory visits with significantly more emergency treatments for step 3 and 4 ( $p = 0.023$ ,  $\chi^2$ -Test). The binary logistic regression revealed a significant relation between depression and unscheduled home visits / ambulatory care ( $p = 0.021$ ; OR 1.58; 95% CI 1.07 to 2.33). There was a significant interaction between asthma severity and depression (as independent variables) concerning the frequency of unscheduled visits / ambulatory care (as dependent variable) ( $p = 0.001$ ).

## Discussion

The results of our study suggest that nearly half of the patients with asthma in primary care are suffering from moderate to severe asthma. In general, one third is treated according to medical guidelines, one third is under-treated and the last third is treated incorrect. QoL was lowest and depression highest in patients who received too low dosage or end-of-dose treatment and QoL and depression were best in patients who received treatment as recommended. Patients with lower QoL and higher depression scores had higher self-management activities irrespective of asthma severity.

The conspicuously adverse distribution of asthma severity is similar to those of huge surveys like the European AIRE study [9] or an US survey [8]. The AIRE study highlighted, that only 5 % of the patients meet all criteria for asthma control. However, strikingly two thirds in this survey reported that they had no asthma

1  
2  
3 symptoms or only mild asthma. Thus, there seems to be an obvious difference  
4 between the self-awareness and the real state of the disease, thus leading to under-  
5 reporting of symptoms during consultations [16,17]. In fact, optimal reporting would  
6 be necessary for optimal treatment. Our study emphasizes the importance of optimal  
7 medical treatment for QoL, and it demonstrates the low QoL of the under-treated  
8 patients, which was as low as in patients with acute exacerbation [18]. The differences  
9 in QoL between optimal treated and under treated patients in our study were  
10 considerably higher compared to the survey of Pont et al. [19]. However, Pont et al.  
11 used spirometry for determining the asthma severity instead of self-assessment as in  
12 our study. Another reason for this difference could be a higher participation rate  
13 (81.5%) in our study compared to Pont et al. (39.6%), suggesting a lower bias towards  
14 healthier patients. In contrast to the under-treated patients, the quality of life of false-  
15 treated patients was comparatively high. These patients need special attention as they  
16 might have a higher risk for exacerbation and hospitalisation because they receive no  
17 steroids [1,2]. The question for optimising medication rises at this point. In fact, more  
18 than 70% of the patients in our survey used ICS. This seems to be a high amount  
19 compared to the AIRE survey, in which only 23% used ICS regularly [9]. It might be  
20 over-ambitious or even inadequate to achieve the goals set by the guidelines, which  
21 are reached by consensus [20] in every patient. Additionally, it has to be taken into  
22 account, that the efficacy of asthma medication is limited, so that about 5% of patients  
23 will suffer from severe asthma despite optimal therapy [21].

24  
25  
26  
27  
28  
29 Another critical point is the low amount of patients receiving education and training  
30 for self-management. The relevance of these measures for reducing disability and  
31 hospitalisation has been shown in various studies [22]. However, two thirds of the  
32 patients in our study did not want to participate in education irrespective of asthma  
33 severity and they were at least using less inhaled steroids. They had remarkably  
34 higher QoL, lower depression scores and lower use of steroids. This could mean that  
35 the optimal self-management may depend more on the perceived burden of illness than  
36 on the actual asthma severity. Urgent improvement of care for those patients is  
37 underlined by the latest results of a national case-control study which isolated fewer  
38 general practice contacts, more home visits and fewer PEF recordings as independent  
39 risk factors for death [23]. It is a challenge for primary care physicians to detect and  
40 motivate these patients in order to prevent a severe deterioration of the disease. One  
41 possibility for improvement could be the provision of feedback to the general  
42 practitioners on the actual state of care for discussion in quality circles [8]. This is  
43 done in a complex intervention, now additionally providing feedback of the 'best  
44 practice' [24]. Future evaluation of this benchmark of care in general practice could  
45 allow determining the best practice management as a model of care for difficult  
46 patients. Indeed, this would also mean that the GPs need more time for the  
47 management of chronically ill patients as the comprehensive therapy demands  
48 intensive communication [25], especially for patients at risk [26].

49  
50  
51  
52  
53 A necessity for improving care is underlined by the high frequency of unscheduled  
54 ambulatory care and home visits and long average hospital stays. Our study suggests  
55 that psychological co-morbidity seems to contribute to this high utilisation. However,  
56 as the data is derived by a cross sectional study, a prospective trial would be necessary  
57 to evaluate the meaning of these findings. Another limitation of the study is a  
58 potential recruitment bias towards more motivated and educated patients as they  
59 needed to fill in questionnaires and to send them back reliably to the study centre.  
60 This would indeed lead to a more optimistic estimation of the present situation. A

1  
2  
3 possible selection of motivated general practitioners would also lead into this  
4 direction. On the other hand, once more this emphasises the urgent necessity to  
5 improve care for these difficult patients.  
6

7 In conclusion, the large variation of asthma severity can partly be explained by  
8 guideline adherence to medication and deficits in patient self-management. However,  
9 there are a high amount of difficult patients who deserve attention for quality  
10 improvement of care. Target-oriented interventions need to be developed to detect and  
11 motivate patients at risk. Eventually, more time should be invested for these  
12 chronically ill patients in order to establish a closer partnership so that patients are  
13 more involved in decision making and engaged personally.  
14  
15  
16  
17

## 18 **Acknowledgements**

19 The study is part of a larger quality improvement project, which is financed by the  
20 German Federal Ministry of Health and Social Security (BMGS); grant No. 217-  
21 43794-6/8  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

1. Suissa S, Ernst P, Benayoun S, Baltzan M, Cai B. Low-dose inhaled corticosteroids and the prevention of death from asthma. *N Engl J Med* 2000; 343: 332-336.
2. Tattersfield AE, Knox AJ, Britton JR, Hall IP. Asthma. *Lancet* 2002; 360: 1313-1322.
3. Schermer TR, Thoonen BP, van den Boom G, Akkermans RP, Grol R, Folgering HT, van Weel C, van Schayck CP. Randomized controlled economic evaluation of asthma self-management in primary health care. *Am J Respir Crit Care Med* 2002; 166: 1062-1072.
4. Thoonen BP, Schermer TR, van den Boom G, Molema J, Folgering H, Akkermans RP, Grol R, van Weel C, van Schayck CP. Self-management of asthma in general practice, asthma control and quality of life: a randomised controlled trial. *Thorax* 2003; 58: 30-36.
5. Stock S, Redaelli M, Luengen M, Wendland G, Civello D, Lauterbach KW. Asthma: prevalence and cost of illness. *Eur Respir J* 2005 ; 25: 47-53.
6. Himmel W, Hummers-Pradier E, Schumann H, Kochen MM. The predictive value of asthma medications to identify individuals with asthma-a study in German general practices. *Br J Gen Pract* 2001; 51: 879-883.
7. Schneider A, Gantner L, Maag I, Borst MM, Wensing M, Szecsenyi J. Are ICD-10 codes appropriate for performance assessment in asthma and COPD in general practice? Results of a cross sectional observational study. *BMC Health Serv Res* 2005; 5: 11.
8. Fuhlbrigge AL, Adams RJ, Guilbert TW, Grant E, Lozano P, Janson SL, Martinez F, Weiss KB, Weiss ST. The burden of asthma in the United States: level and distribution are dependent on interpretation of the national asthma education and prevention program guidelines. *Am J Respir Crit Care Med* 2002; 166: 1044-1049.
9. Rabe KF, Vermeire PA, Soriano JB, Maier WC. Clinical management of asthma in 1999: the Asthma Insights and Reality in Europe (AIRE) study. *Eur Respir J* 2000 ; 16: 802-807.
10. Wensing M, Broge B, Kaufmann-Kolle P, Andres E, Szecsenyi J. Quality circles to improve prescribing patterns in primary medical care: what is their actual impact? *J Eval Clin Pract* 2004; 10: 457-466.
11. Juniper EF, Buist AS, Cox FM, Ferrie PJ, King DR. Validation of a standardized version of the Asthma Quality of Life Questionnaire. *Chest* 1999; 115: 1265-1270.

12. Juniper EF, Guyatt GH, Willan A, Griffith LE. Determining a minimal important change in a disease-specific Quality of Life Questionnaire. *J Clin Epidemiol* 1994; 47: 81-87.
13. Juniper EF, Wisniewski ME, Cox FM, Emmett AH, Nielsen KE, O'Byrne PM. Relationship between quality of life and clinical status in asthma: a factor analysis. *Eur Respir J* 2004 : 23: 287-291.
14. Lowe B, Spitzer RL, Grafe K, Kroenke K, Quenter A, Zipfel S, Buchholz C, Witte S, Herzog W. Comparative validity of three screening questionnaires for DSM-IV depressive disorders and physicians' diagnoses. *J Affect Disord* 2004; 78: 131-140.
15. National Institute of Health. Global Initiative for Asthma - Global Strategy for Asthma Management and Prevention. [www.ginasthma.com](http://www.ginasthma.com). Date last accessed: December 7 2005.
16. van Schayck CP, Der Heijden FM, van den Boom G, Tirimanna PR, van Herwaarden CL. Underdiagnosis of asthma: is the doctor or the patient to blame? The DIMCA project. *Thorax* 2000; 55: 562-565.
17. van Weel C. Underdiagnosis of asthma and COPD: is the general practitioner to blame? *Monaldi Arch Chest Dis* 2002, 57: 65-68.
18. Juniper EF, Svensson K, Mork AC, Stahl E. Measuring health-related quality of life in adults during an acute asthma exacerbation. *Chest* 2004; 125: 93-97.
19. Pont LG, van der Molen T, Denig P, van der Werf GT, Haaijer-Ruskamp FM. Relationship between guideline treatment and health-related quality of life in asthma. *Eur Respir J* 2004 : 23: 718-722.
20. Kips JC, Pauwels RA. Asthma control: where do we fail? *Eur Respir J* 2000; 16: 797-798.
21. Barnes PJ, Woolcock AJ. Difficult asthma. *Eur Respir J* 1998; 12: 1209-1218.
22. Gibson PG, Powell H, Coughlan J, Wilson AJ, Abramson M, Haywood P, Bauman A, Hensley MJ, Walters EH. Self-management education and regular practitioner review for adults with asthma. *Cochrane Database Syst Rev* 2003: CD001117.
23. Sturdy PM, Butland BK, Anderson HR, Ayres JG, Bland JM, Harrison BD, Peckitt C, Victor CR. Deaths certified as asthma and use of medical services: a national case-control study. *Thorax* 2005; 60: 909-915.
24. Weissman NW, Allison JJ, Kiefe CI, Farmer RM, Weaver MT, Williams OD, Child IG, Pemberton JH, Brown KC, Baker CS. Achievable benchmarks of care: the ABCs of benchmarking. *J Eval Clin Pract* 1999; 5: 269-281.
25. Caress AL, Beaver K, Luker K, Campbell M, Woodcock A. Involvement in treatment decisions: what do adults with asthma want and what do they get? Results of a cross sectional survey. *Thorax* 2005; 60: 199-205.

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
26. Smith JR, Mildenhall S, Noble MJ, Shepstone L, Koutantji M, Mugford M, Harrison BD. The Coping with Asthma study: a randomised controlled trial of a home-based, nurse-led, psycho-educational intervention for adults at risk of adverse asthma outcomes. *Thorax* 2005. Epub ahead of print.

## Tables

**Table 1 - Baseline Characteristics compared to severity of asthma (n=256)**

Asthma step at day	Symptoms	All patients	Female	Age	Depression	AQLQ sum
		n (%)	n (%)	Mean (sd)	Mean (sd)	Mean (sd)
1	Symptoms less than once a week.	59 (23.0)	35 (59.3)	52.58 (18.27)	3.67 (3.57)	5.46 (0.93)
2	Symptoms more than once a week but less than once a day.	63 (24.6)	43 (68.3)	54.71 (17.49)	5.65 (3.92)	4.67 (1.0)
3	Symptoms daily, but not continuously.	92 (35.9)	55 (59.8)	57.10 (13.98)	7.59 (4.80)	3.83 (0.98)
4	Symptoms continuously with limitation to physical activities.	19 (7.4)	14 (73.7)	60.25 (13.17)	8.94 (5.32)	3.16 (0.74)
Missing		23 (8.9)	11 (47.8)	62.80 (18.27)	2.67 (4.05)	5.80 (1.08)
ANOVA				p = 0.213 F = 1.51	<b>p &lt; 0.001</b> F = 12.33	<b>p &lt; 0.001</b> F = 45.39
<b>Asthma step at night</b>						
1	Nocturnal symptoms not more than twice a month.	93 (23.3)	59 (63.4)	53.71 (17.23)	4.63 (4.07)	5.00 (0.99)
2	Nocturnal symptoms more than twice a month.	45 (17.6)	31 (68.9)	53.54 (16.74)	6.34 (3.96)	4.39 (0.98)
3	Nocturnal symptoms more than once a week, but not every night.	73 (28.5)	45 (61.6)	57.03 (14.88)	7.86 (5.02)	3.70 (0.95)
4	Frequent nocturnal asthma symptoms.	15 (5.9)	9 (60.0)	63.10 (9.52)	9.57 (3.27)	2.98 (0.66)
Missing		30 (11.7)	14 (46.7)	62.71 (17.37)	1.75 (3.24)	5.87 (0.94)
ANOVA				p = 0.124 F = 1.94	<b>p &lt; 0.001</b> F = 10.09	<b>p &lt; 0.001</b> F = 40.41

**Table 2 - Medication and quality of life in correlation with asthma steps (n=233; 23 patients missing as they reported no asthma step)**

Asthma step at day	n	Full adherence to guidelines	Guideline adherence, but dosage too low (Step 2: all patients with symptoms step 3 at night)	Guideline adherence, but end-of-dose, patient in step 3 or 4	No guideline adherence, patient in step1 or 2	No guideline adherence, patient in step 3 or 4	ANOVA	
<b>1</b> [n (%)]	59	50 (21.5)	---	---	9 (3.9)	---	<b>p &lt; 0.001</b>	F = 9.47
<b>2</b> [n (%)]	63	36 (15.5)	10 (4.3)	---	17 (7.3)	---	<b>p &lt; 0.001</b>	F = 25.17
<b>3</b> [n (%)]	92	---	56 (24.0)	14 (5.6)	---	22 (9.4)	<b>p &lt; 0.001</b>	F = 29.82
<b>4</b> [n (%)]	19	---	14 (6.0)	3 (1.3)	---	2 (0.9)	<b>p &lt; 0.001</b>	F = 24.83
<b>Sum</b> [n (%)]	233	86 (36.9)	80 (34.3)	17 (7.3)	26 (11.2)	24 (10.3)	<b>p &lt; 0.001</b>	F = 29.76
<b>Scales</b>							<b>ANOVA</b>	
<b>Depression</b> [mean (sd)]		4.46 (3.61)	7.89 (4.77)	9.06 (4.63)	4.45 (4.71)	6.30 (4.70)	<b>p &lt; 0.001</b>	F = 9.47
<b>Activity</b> [mean (sd)]		5.31 (0.92)	3.90 (1.02)	3.17 (0.89)	4.88 (1.40)	4.42 (1.01)	<b>p &lt; 0.001</b>	F = 25.17
<b>Symptoms</b> [mean (sd)]		5.11 (1.06)	3.56 (1.00)	2.96 (0.86)	5.13 (1.33)	4.28 (0.95)	<b>p &lt; 0.001</b>	F = 29.82
<b>Emotion</b> [mean (sd)]		5.35 (1.11)	3.84 (1.30)	3.06 (0.90)	5.32 (1.27)	4.38 (1.18)	<b>p &lt; 0.001</b>	F = 24.83
<b>Environment</b> [mean (sd)]		4.88 (1.13)	3.67 (1.13)	2.85 (1.13)	4.93 (1.15)	4.29 (1.08)	<b>p &lt; 0.001</b>	F = 18.37
<b>AQLQ sum</b> [mean (sd)]		5.19 (0.94)	3.75 (0.93)	3.01 (0.82)	5.04 (1.32)	4.34 (0.89)	<b>p &lt; 0.001</b>	F = 29.76

**Table 3: Self-management, education, hospitalisation and unscheduled ambulatory care (n= 256)**

	Step 1 (n=59)	Step 2 (n=63)	Step 3 (n=92)	Step 4 (n=19)	Depression	AQLQ sum
<b>Education / self-management</b>						
I have already received education. [n (%)]	14 (37.7)	18 (28.6)	28 (30.4)	9 (47.4)	7.46 (5.16)	4.07 (1.15)
I did not receive education. [n (%)]	44 (47.7)	38 (60.3)	62 (67.4)	9 (47.4)	5.30 (4.41)	4.71 (1.22)
					<b>p = 0.002</b>	<b>p &lt; 0.001</b>
I have a peak flow meter at home. [n (%)]	10 (16.9)	18 (28.6)	21 (22.8)	5 (26.3)	7.72 (5.35)	4.04 (1.26)
I do not have a peak flow meter. [n (%)]	47 (79.7)	37 (58.7)	70 (76.1)	14 (73.7)	5.42 (4.39)	4.64 (1.22)
					<b>p = 0.002</b>	<b>p = 0.002</b>
I use an asthma diary with a peak flow protocol. [n (%)]	0 (0)	4 (6.3)	6 (6.5)	1 (5.3)	11.73 (7.79)	3.31 (1.24)
I do not use any diary or protocol. [n (%)]	57 (96.6)	52 (82.5)	86 (93.5)	18 (94.7)	5.69 (4.33)	4.56 (1.22)
					<b>p = 0.028</b>	<b>p = 0.001</b>
I have a personal emergency plan at home. [n (%)]	4 (6.8)	7 (11.1)	7 (7.6)	3 (15.8)	9.10 (6.65)	3.62 (1.07)
I do not have a personal emergency plan. [n (%)]	52 (88.1)	49 (77.7)	81 (88.0)	16 (84.2)	5.67 (4.41)	4.60 (1.22)
					<b>p = 0.002</b>	<b>p &lt; 0.001</b>
<b>Hospital / unscheduled visits because of asthma</b>						
Hospital admission within the last 12 months. [n (%)]	1 (1.7)	5 (7.9)	10 (10.9)	2 (10.5)	10.50 (3.97)	3.11 (0.85)
I was not in hospital. [n (%)]	54 (91.5)	53 (84.1)	79 (85.9)	16 (84.2)	5.60 (4.60)	4.63 (1.21)
Length of stay [mean (sd)]	45 (-)	13.75 (14.24)	20.25 (13.64)	12.50 (2.12)	<b>p = 0.007</b>	<b>p = 0.017</b>
Unscheduled visits within the last 12 months. [n (%)]	9 (15.3)	5 (7.9)	13 (14.1)	7 (36.8)	8.91 (5.94)	3.53 (0.95)
I had no unscheduled visits. [n (%)]	42 (71.1)	47 (74.6)	74 (80.4)	10 (52.6)	5.49 (4.26)	4.69 (1.24)
Amount of treatments [mean (sd)]	1.75 (0.71)	2.25 (0.50)	3.57 (2.82)	4.86 (3.44)	<b>p = 0.003</b>	<b>p &lt; 0.001</b>

**Table 4: Risk patients, stratified by motivation for education and medication with guideline adherence (patients who did not receive education in advance) (n=155)**

<b>I would like to receive asthma education.</b>	<b>Step 1 (n=44)</b>	<b>Step 2 (n=36)</b>	<b>Step 3 (n=53)</b>	<b>Step 4 (n=9)</b>
<b>Yes [n %]</b>	10 (22.7)	12 (33.3)	25 (47.2)	6 (66.7)
AQLQ sum [mean (sd)]	5.21 (0.94)	5.09 (0.85)	3.58 (0.88)	3.26 (1.07)
Depression [mean (sd)]	5.00 (3.83)	4.50 (4.36)	8.92 (4.86)	7.8 (4.97)
Using inhaled steroids [n (%)]	7 (70.0)	9 (75.0)	23 (92.0)	5 (83.3)
Still smoking [n (%)]	5 (50)	3 (25.0)	5 (9.4)	1 (16.6)
<b>No [n %]</b>	34 (77.3)	24 (66.7)	28 (52.8)	3 (33.3)
AQLQ sum [mean (sd)]	5.80 (0.73)	4.66 (0.95)	4.35 (1.04)	3.31 (0.19)
Depression [mean (sd)]	2.94 (3.37)	5.14 (3.10)	5.82 (4.48)	7.67 (5.03)
Using inhaled steroids [n (%)]	18 (52.9)	18 (75.0)	18 (72.0)	2 (66.6)
Still smoking [n (%)]	10 (29.4)	6 (25.0)	8 (28.6)	1 (33.3)
t-Test (AQLQ sum)	<b>p = 0.042</b>	p = 0.202	<b>p = 0.006</b>	p = 0.935
t-Test (Depression)	p = 0.107	p = 0.658	<b>p = 0.021</b>	p = 0.972
$\chi^2$ -Test (receiving inhaled steroids)	p = 0.338	p = 1.00	<b>p = 0.016</b>	p = 0.571
$\chi^2$ -Test (still smoking)	p = 0.227	p = 1.000	p = 0.469	p = 0.571