How Should We Quantify Asthma Control?*
A Proposal

Louis-Philippe Boulet, MD, FCCP; Véronique Boulet; and Joanne Milot, BSc

Background: Current asthma guidelines suggest a series of criteria to assess if asthma is controlled. However, there is a need to develop a simple and practical method to quantify the degree of such control, both in clinical practice and research.

Study objectives: This report describes a new method to quantify asthma control based on a percentage score. It also aims at comparing the percentage scores obtained with patient’s self-evaluation of asthma control and a current validated Mini Asthma Quality of Life (MAQOL) questionnaire.

Setting and subjects: Forty-two subjects (25 female and 17 male patients) with asthma of different severity recruited from a tertiary center asthma clinic.

Methods: The asthma scoring method provided a percentage control for symptoms, baseline expiratory flows and, an optional parameter, for airway inflammation assessed from induced-sputum eosinophil count. These control parameters were compared to an overall assessment of asthma control by the patient (also on a 100% scale) and the score obtained from a validated MAQOL questionnaire.

Results: Mean ± SEM scores for symptoms, expiratory flows, and airway eosinophilia (last 2 weeks) were 87.8 ± 1.4%, 88.6 ± 1.8%, and 66.2 ± 3.9%, respectively. No significant correlation was found between these three parameters (p > 0.05). The mean global asthma control score and the score estimated by the patient were 80.9 ± 1.5% and 91.7 ± 1.5%, respectively (not significantly different). There was a significant correlation between asthma control score (percentage) and percentage symptom score (p < 0.001), while it almost achieved significance for FEV1 (p = 0.05). Only symptom scores correlated with the MAQOL questionnaire.

Conclusions: We developed a simple easy-to-use asthma control scoring system based on a percentage of optimal control. The percentage symptom score but not the global control score of this new method correlated with patient’s global assessment of asthma control. This could be a simple tool that is potentially useful both for the clinician and for research purposes, to quantify global or specific aspects of asthma control.

(CHEST 2002; 122:2217–2223)

Key words: asthma control; asthma treatment

Abbreviation: MAQOL = Mini Asthma Quality of Life

Most asthma guidelines recommend assessing asthma control according to a series of criteria based on symptoms and pulmonary function.1,2 Asthma treatment should aim at minimizing symptoms, rescue bronchodilator need, and exacerbations, while optimizing pulmonary function. Recently, methods for assessing airway inflammation noninvasively have been developed, but they are not currently integrated into the assessment of asthma control.3,4 Studies or surveys on asthma generally use an “all or none” approach or a strictly qualitative evaluation of asthma control, without specific quantification of its magnitude or degree compared with optimal goals. Other means of assessing these parameters include evaluating or scoring each separate component of asthma control and comparing the effects of treatment or interventions on these specific parameters.

In current practice, however, both patients and physicians assess asthma control globally, although there is no simple, practical method for truly quantifying it. This may contribute to an overestimate of
the adequacy of asthma control by the physician, and even more so by the patient, and may consequently contribute to the poor asthma control observed in the asthmatic population when current guideline criteria are used.\textsuperscript{5-7} Such deficiency in the evaluation of asthma control or severity may be related to the infrequent use of specific criteria as proposed by clinical practice guidelines and the absence of objective measures of airflow obstruction.\textsuperscript{5,8,9}

Quantification of control with tools such as the validated questionnaire developed by Juniper et al\textsuperscript{10} has been welcomed, providing a most interesting way to assess asthma control. However, busy clinicians may not have the time or personnel required for administering such questionnaires, and the scoring system used may not necessarily be meaningful to the practitioner and the patient.

There remains, therefore, a need for simple new methods for globally assessing and quantifying the degree of asthma control in a given patient or group of patients, and for evaluating the effects of certain therapeutic interventions on this control. Any such method will need to be flexible, so that it may be customized to meet the physician’s and patient’s individual needs. It should ideally be applicable both in the physician’s office and in the context of clinical research. This report describes a new, simple, and practical method for quantifying asthma control based on a global percentage score, and compares its results with those obtained from patient self-evaluation of control and a current validated quality-of-life questionnaire.

**Materials and Methods**

This survey was done in 42 consecutive patients (25 female and 17 male patients) with asthma of different degrees of severity attending the Laval Hospital Asthma Clinic and Clinical Research Center. Mean age was 34.8 years (SEM, 2.3). All were receiving an inhaled corticosteroid (mean daily dose, 744 \(\mu\)g [SEM, 94]), and 7 patients were receiving a long-acting \(\beta_2\)-agonist (salmeterol, 50 \(\mu\)g bid; or formoterol, 12 \(\mu\)g bid).

**Study Design**

Each subject underwent an evaluation that included the new asthma control questionnaire during a session in which a spirometry was performed and induced-sputum obtained. A validated Mini Asthma Quality of Life (MAQOL) questionnaire was also completed.\textsuperscript{11}

**Quantitative Evaluation of Asthma Control**

Three types of parameters were obtained by the tested control questionnaire: (1) respiratory symptoms, quantified as a percentage score according to the frequency of symptoms; (2) physiologic parameters, expressed as the patient’s best measure of FEV\textsubscript{1} in percentage of predicted value, measured with a wedged spirometer, which fulfilled the requirements of the American Thoracic Society; and (3) airway inflammation, assessed as the percentage eosinophil count of induced-sputum samples (Fig 1). Response to bronchodilators was not assessed in this study. The different elements were quantified to obtain a total score of 100% for each subsection of the evaluation, and a global score was determined by calculating the mean for these three different types of parameters according to their respective predetermined weights. This method is flexible and allows for a quantification of asthma control criteria according to the user’s preference, as different weights can be attributed to the various parameters. For example, for a global score based only on symptoms and pulmonary function, each could have a 50% weight (Fig 2). If inflammation is added, it may have an equal weight, the sum of the three scores (each in percentage) being divided by three, although one can also note the three scores separately to provide an overview of the three components of asthma.

**Asthma Quality-of-Life Questionnaire**

The MAQOL questionnaire developed by Juniper et al\textsuperscript{11} was administered at the same time as the evaluation described above. This questionnaire comprises 15 questions on different aspects of current daily activities.

**Global Patient Evaluation of Asthma Control**

Patients were asked to score their degree of asthma control on a scale from 0 to 100%, without being given any specific criteria for determining this score.

**Airway Eosinophilia From Induced-Sputum Analysis**

For each patient, the percentage of eosinophils was assessed from induced-sputum analysis at a time when their asthma was stable, according to method described by Pizzichini et al.\textsuperscript{12} We chose the following scoring according to the percentage eosinophil count in sputum: 0 = 100%, < 2% = 80%, 2 to 5% = 60%, > 5 to 8% = 40%, and > 8% = 20%.

**Statistical Analysis**

Means (SEM) were determined for continuous variables and percentage for categorical variables. Relationships between parameters were expressed with the Pearson correlation coefficients as the linearity between these parameters was observed. The results were considered significant if \(p\) values were < 0.05. The data were analyzed using software (SAS; SAS Institute, Cary, NC).

**Results**

The percentage control score for the last 2 weeks of clinical assessment went from 60 to 100% (mean \(\pm\) SEM, 87.8 \(\pm\) 1.4\%) [Fig 2]. For FEV\textsubscript{1} (percentage of optimal value, patient’s best FEV\textsubscript{1} in percentage of predicted value), percentage control score went from 40 to 100% (mean, 88.6 \(\pm\) 1.8\%).

For the quality-of-life questionnaire, the global score was 5.99 \(\pm\) 0.13; it was 5.83 \(\pm\) 0.16 for symptoms, 6.29 \(\pm\) 0.11 for activity limitation, 6.23 \(\pm\) 0.14 for emotional function, and 5.63 \(\pm\) 0.19 for environmental stimuli. Patient global assessment \((n = 38)\) went from 50 to 100 (mean, 91.7 \(\pm\) 1.5). The number of eosinophils in induced-sputum samples went from a 20 to 100% score (mean, 66.2 \(\pm\) 3.9\%).
Correlations Between the Different Parameters

No significant correlation was found between mean scores for symptoms, expiratory flows, and airway inflammation (p > 0.05; Fig 3). Only symptom scores correlated with quality of life (Fig 4; p < 0.001, r = 0.726).

There was a significant correlation between patient’s self-evaluation of control and symptom scores (p < 0.001), while the correlation almost achieved significance for FEV₁ (p = 0.05). We found a significant correlation for the symptoms and the MAQOL questionnaire compared with the patient’s global assessment of asthma control (p < 0.001, Fig 5).

Discussion

The main goal of asthma treatment is to achieve adequate control of the disease in order to reduce its consequences and, ideally, its severity over time.¹² This can be obtained through patient education, environmental control, and individualized pharmacotherapy.
Although current clinical practice guidelines suggest specific criteria for assessing asthma control, and various questionnaires have been proposed to assess those criteria, there are very few methods available for globally quantifying such control.\textsuperscript{11,13,14} Furthermore, we have evidence that current guidelines are often not known or used by physicians, and that asthma control is often far from being adequate.\textsuperscript{5,7,9,15}

Although the methods that have been validated for evaluating severity and control of asthma seem to be useful in research settings, they are not being widely used in practice. This may be because of the time and resources required to gather the information, or because of a perception among patients and physicians that these newer methods are no more useful than their current means of global evaluation. In general practice, assessment of asthma control is based primarily on symptoms and daily activities.

![Figure 2](image1.png)

**Figure 2.** Asthma control scoring. *Left:* mean percentage control score \((n = 42)* for clinical assessment, expiratory flows, and airway eosinophilia. *Right:* mean percentage score \((n = 42)* for each parameter of the clinical assessment. The maximum score for each parameter is 25% (global score of 100%). BD = bronchodilator.

![Figure 3](image2.png)

**Figure 3.** Asthma control score (% control, last 2 weeks) for clinical, physiologic, and inflammatory assessment. There are no significant correlations between these parameters. pred = predicted. The dots may represent the results of more than one subject.
rather than on objective measurements of airflow obstruction, such as spirometry, which are rarely done.\textsuperscript{9,16} New methods of evaluation of airway inflammation, such as induced-sputum analysis, are not currently integrated into asthma care, and their role remains to be defined.\textsuperscript{4}

Asthma control can be measured in many ways. Monitoring respiratory symptoms, airflow obstruction, and asthma exacerbations is considered essential to asthma management.\textsuperscript{17} As reviewed by Gibson et al,\textsuperscript{18} patients who practice self-monitoring in conjunction with the use of a written action plan and regular medical review have significantly fewer hospitalizations, emergency department visits, and lost time from work. We have previously shown that both symptoms and peak expiratory flow monitoring interpreted with reference to the patient’s best values were effective in maintaining asthma control, although peak expiratory flow monitoring was not superior to symptom monitoring for adjusting the treatment according to an action plan.\textsuperscript{19}

However, while asthma control must be assessed...
in order to adjust therapy, it is rarely quantified or assessed properly. We believed that there was a need to develop a simple and practical method, not only as an aid to clinical practice, but also to be used in the context of asthma research to quantify asthma control. We therefore proposed a new method for quantifying asthma control based on a zero to 100% score. This evaluation tool is flexible; it can be based on symptoms, expiratory flows, or even airway inflammation if one wishes to do so. The method is simple, practical, and uses a scoring system that is familiar to most people. It also enables the user to assess different components of asthma control, and to determine their relative importance by weighing them. It may also serve as an incentive for the physician and patient to improve disease control by allowing better monitoring and assessment of progress toward adequate control.

The present model incorporates the three most typical asthma manifestations: respiratory symptoms, changes in expiratory flows, and airway inflammation. Measurement of airway eosinophilia is not currently integrated into clinical practice and induced-sputum analysis is being used increasingly, particularly in specialized centers and in research on asthma therapy.3,20 Finally, we could not compare our scoring tool to the more recently developed Asthma Control Questionnaire,10 as it was not available in a validated form in French at the time of the evaluation.

The relationships between symptom, expiratory flows, and airway inflammation are quite variable.21,22 Our observations further stress that asthma control assessment may significantly vary according to the outcome parameters used. The fact that the “respiratory symptoms” component of the control score correlated with patient’s global control assessment not only shows that the perceived discomfort caused by the disease is the main criteria used by patients to seek medical attention or rate the control of asthma, but confirms the poor correlation with pulmonary function, even in patients with mildly to moderately uncontrolled asthma.

We may question the need for measures other than symptoms to assess asthma control. However, the poor correlation between symptoms and pulmonary function in some patients,23 and studies such as reported by Sont et al24 on the use of measures or airway responsiveness to determine medication needs suggest that measures of physiologic parameters, and maybe inflammation, can contribute to a more adequate assessment of treatments needs in order to reduce asthma-related morbidity.

Most patients evaluated in this “pilot study” had relatively well-controlled asthma. It will be of interest to study patients with moderately to markedly uncontrolled asthma, for example in recruiting patients during an acute episode of asthma exacerbation and after treatment. This would, however, be another study, but the method should apply whatever the degree of asthma control loss. We should therefore pursue the comparisons of the new scoring system in other groups of patients and with other recently available asthma control scores, in patients of different asthma severity/control. Nevertheless, such tools are needed to improve and better quantify the assessment of asthma control; such methods should ideally be simple and user friendly, at least in clinical settings.

Furthermore, in regard to measures of airway inflammation, it can be assessed by various methods. We chose the quantification of eosinophils in induced sputum, as this method is increasingly used and its variability had been studied in the normal and asthmatic populations.25 Airway inflammation could be assessed by other methods such as exhaled nitric oxide or other types of noninvasive measurements.26 Some of these last could become easy and inexpensive to use, providing other parameters to quantify airway inflammation. These measures are usually affected by treatment, and although it is our goal to see the adequacy of treatment as suppressor of inflammation, we should choose a method that would best reflect the overall inflammatory process and its control.

In conclusion, an “ideal” measure of asthma control may be regarded as requiring the following characteristics: simple; practical; meaningful; applicable to patients, clinicians, and researchers; reflecting long-term asthma control; discriminatory; and responsive to change. The issue of asthma control is not a binary decision, and there is a need to develop a valid quantitative or semi-quantitative description of asthma control. In keeping with this goal, we propose an easy-to-use asthma control scoring tool based on a percentage score. We think this could be useful both for the clinician and for research purposes, to quantify global or specific aspects of asthma control. The differences between clinical, physiologic, and bronchial inflammatory scores illustrate the discrepancies between the various expressions of the disease. A simple quantification of the various expressions of the disease may help the physician to better assess what is the best therapeutic approach for a given patient or, in clinical trials, to evaluate global changes in asthma control following a specific intervention.

ACKNOWLEDGMENT: We are grateful to Mariette Veillette, Sylvie Carette, and Lori Henig Schubert for their help with the preparation of this article.
REFERENCES