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## PEF measurements

# Usefulness of peak expiratory flow measurements: is it just a matter of instrument accuracy?

## V Brusasco

A method for improving the accuracy of peak flow meters will be valuable if the recommendation to measure PEF is to be maintained in asthma management plans. With the currently available peak flow meters, no evidence has been provided that PEF measurements are of clinical usefulness. A large number of new randomised controlled studies using optimally validated peak flow meters would therefore be necessary. However, by that time these instruments may have become obsolete.

In this issue of *Thorax* Miller *et al*<sup>1</sup> present a new method for validation of peak flow meters. They show that applying a computer driven explosive decompression can detect inaccuracies in the dynamic response of commercially available peak flow meters that would be missed using the ATS recommended 26 waveforms for spirometer validation. This work is justified by the compelling recommendations to use peak expiratory flow (PEF) as a main or sole measure of lung function, incorporated in the current guidelines for diagnosis and management of asthma.<sup>2–5</sup> In particular, PEF is recommended for daily home monitoring and also as a criterion for admission and discharge from the emergency room. For either application, accuracy of measurement is an obvious prerequisite. Indeed, previous works have shown that commercially available peak flow meters

may not be accurate enough to allow correct management of a number of asthmatic subjects.<sup>6,7</sup> As Miller *et al*<sup>1</sup> correctly point out, a major clinical problem may arise from falsely high readings when underdamped peak flow meters are used,<sup>8</sup> thus leading to potentially dangerous underestimation of the severity of airway obstruction.

In theory, an efficient way to monitor lung function in asthma should improve its management and clinical outcomes. This was the rationale that prompted an expert panel to recommend home measurements of PEF as a key component of action plans for asthma care. However, 10 years after the first introduction of asthma guidelines, evidence that home measurements of PEF flow with portable flow meters can substantially modify asthma management and outcomes is still lacking. Rather, the near totality of

the randomised controlled studies so far published suggests the contrary. A recent Cochrane review of the available randomised controlled studies indicates that written action plans based on PEF are not superior to symptom based plans in the self-management of asthma in adults.<sup>9</sup>

Several reasons have been invoked to explain the lack of usefulness of PEF in asthma monitoring. Firstly, changes in PEF may not accurately reflect changes in airway function as assessed by more reliable measurements such as forced expiratory flow in 1 second (FEV<sub>1</sub>) or forced vital capacity. Although discrepancies between PEF and FEV<sub>1</sub> may in part be related to inaccuracy of portable flow meters, these two measurements may differ because of the greater sensitivity of PEF to upper airway function and the effects of expiratory effort, which depend on factors other than airway function including mood in non-supervised self-assessment.<sup>10</sup> Secondly, compliance with daily PEF measurements has been shown to be low and decreases with time.<sup>11,12</sup> A possibility exists that patients lack confidence in PEF because of its relative insensitivity to detect exacerbations compared with symptoms.<sup>13</sup> This in turn may depend, at least in part, on the relative insensitivity of PEF to changes in airway calibre and on the inaccuracy of measurements, which may be ameliorated by using a more appropriate calibration procedure like the one proposed by Miller *et al*<sup>1</sup> in this issue of *Thorax*. However, it is also possible that some patients are discouraged from using PEF because deep inspiration, which is required for its measurements, may cause<sup>14</sup> or worsen<sup>15</sup> bronchoconstriction. Whatever the reason, PEF data from diaries have been found to be unreliable because they have been incorrectly recorded or even fabricated, not only in subjects being studied

for occupational asthma<sup>16</sup> but also in children well motivated and informed about the importance of PEF measurements for adjustment of treatment.<sup>12</sup>

An argument in favour of PEF measurements is the possibility of detecting deterioration in airway function in a small proportion of asthmatic subjects who also perceive symptoms poorly.<sup>17</sup> However, the available data suggest that changes in treatment are more likely to be undertaken by patients on the basis of symptoms than on changes in PEF.<sup>18</sup> Furthermore, as PEF may decrease after the onset of symptoms, adjustment of treatment based on PEF may only delay appropriate treatment.<sup>13</sup>

The use of PEF as a guide for admission or discharge of asthmatic patients from the emergency room has not been proved. A recent non-randomised prospective controlled study found that discharge of patients before complete resolution of symptoms and with PEF still below the recommended threshold did not increase the risk of early relapse.<sup>19</sup> Furthermore, decisions on treatment adjustment or even emergency admission and discharge would vary greatly depending on whether the severity of an episode is defined using population based predicted or personal best values.<sup>20, 21</sup>

Finally, recommendations for PEF use in asthma are mainly based on the assumption that PEF variability reflects, to some extent, airway hyperresponsiveness which is the key functional characteristic of bronchial asthma. This relationship was, however, found to be very weak.<sup>22</sup> A recent community based survey has shown that indexes derived from PEF measurements are useless in detecting subjects with an established diagnosis of asthma, while the methacholine dose causing a fall in FEV<sub>1</sub> of 20% is the best measurement of asthma.<sup>23</sup>

In conclusion, no evidence has so far been provided to justify the inclusion of PEF measurement in asthma management plans. This recommendation

should therefore be removed unless it can be shown that improving the accuracy of peak flow meters also improves compliance and clinical outcomes. For this purpose a more suitable method for assessing the dynamic characteristics of the instruments, like the one elegantly described by Miller *et al*,<sup>1</sup> may be valuable. The question is whether, by the time a sufficiently large number of new randomised controlled studies are completed, the peak flow meter will not become obsolete.

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