Eleven peak flow meters: a clinical evaluation

To the Editor:

The introduction of several new types of inexpensive hand-held peak flow meters has given rise to much confusion and this has been compounded by the existence of two entirely different scales in which peak expiratory flow (PEF) may be measured. The intention of the study by Folgering et al. [1], reported in the January issue of the Journal, was to resolve this confusion by evaluating the accuracy, reproducibility and linearity of seven standard range and four low range hand-held meters. It is regrettable, therefore, that a study with such commendable aims was so seriously flawed that its findings and conclusions, so far from reducing present confusion, will have served only to increase it.

Surprisingly, the authors did not refer to a previous study [2] that they presented at the 1993 meeting of the European Respiratory Society, whose methods, findings and conclusions were virtually identical to those of their recent study. In conversation and correspondence with one of the authors, I drew attention to the fact that whereas most of the meters they had studied were calibrated on the "ATS" scale adopted by the American Thoracic Society (ATS), some were calibrated on the "Wright" scale introduced in 1959 by Wright and McKerrow [3] and regarded in a word that denotes equality of the spacing between divisions on a calibration scale. Linearity, on the other hand, signifies the correspondence between values measured by a given instrument and those measured by another instrument whose scale is considered to have the closest resemblance to "true" values.

Airflow within the bronchi can only be estimated indirectly. The development of computerized mechanical rigs [6] led to the establishment of the ATS scale of PEF, which many workers believe has a linear relationship to bronchial airflow and therefore reflects it more accurately than the Wright scale. Nevertheless, the latter has served clinical practice well for almost forty years.

The existence of two scales of PEF has already caused much confusion and there is an urgent need to clarify some of the issues. Recognizing how much excellent research in respiratory diseases has been done in the Netherlands, it was disappointing that a mistake in methodology and a failure of peer review to detect it led to a valuable opportunity having been lost.

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References
When monitoring physiological parameters, one can use two types of instruments: monitors and meters. Monitors are instruments that give an impression of changes in physiological parameters and have no pretensions of accurate measurements. Meters are instruments of which one might expect some accuracy and reproducibility. As the manufacturers of the mini-Wright peak flow meter claim that their instrument is a meter, one should be able to expect that the indications that this meter gives, are representative for actual values of airflow. The mini-Wright peak flow meter comes with two scales: the Wright scale, which is equidistant and this was tested in our study, and the so-called American Thoracic Society (ATS) scale, which is nonequidistant.

The scales on both instruments clearly state that they indicate a value of peak flow in L·min⁻¹. It is somewhat surprising that a manufacturer markets an instrument with two different scales and claims that they are real “meters”.

In our study, we did nothing more than compare the values shown by the mini-Wright peak flow “meter” with the values of a calibrated pneumotachograph. We were very well aware of the difference in scales, but we were just as well aware of the fact that both scales suggested that the instrument could measure flows in L·min⁻¹. The Ferraris meter also had an equidistant scale, and this pocket peak flow meter also claims that it is a “meter” in L·min⁻¹. It would have been more correct to call both instruments peak flow monitors instead of peak flow meters.

We are fully aware of the development of mechanical rigs that can generate a number of patterns of flow volume curves. We never claimed that we did such a kind of calibration and the title of our paper makes that very clear to all readers.

Patients use peak flow meters at home, and also attend hospital for lung function measurements. It would be in the interest of the patients, and of the doctors, to have measurements in which numerical values are comparable, as much as is possible. Any kind of recalculation, either by equations or by scale conversions, would be wasted work. As the manufacturers make such claims, it can be and ought to be tested against a reference apparatus. This can either be a computer-driven syringe, or a reference flow meter. Irrespective of linear or nonlinear scales, the indication of L·min⁻¹ should be valid, if the manufacturer makes such claims. The official European Respiratory Society (ERS) statement on peak expiratory flow measurements [1] states that: “the reading from the meter should be linearly related to the flow delivered by the calibration device”. This was clearly not the case in several meters in our study, if one accepts a human subject also a flow generating calibration device.

Another potential hazard of nonlinear relationships between real flows and scales on peak flow meters is the possible under-reading in the high zones and the over-reading in the intermediate zones, as occurs with several peak flow meters. This would mean that when the real flow decreases, the peak flow meter will hardly detect the decrease. Thus a deterioration in lung function would go unnoticed for some time with these nonlinear meters.

Pedersen et al. claim that “comparing meters with different scales without correction is misleading”. I would submit that putting scales on meters, and claiming to measure flows in L·min⁻¹, is misleading!

Pedersen concludes in his last paragraph that: “the justification for more publications describing conventional and new peak expiratory flow of spirometric devices in the European Respiratory Journal must be that either some new scientific dimension is added to our knowledge, or special features should be described, for example new principles of measurement or new and special applications: It is my opinion that the justification for more publications describing new peak flow meters should not necessarily be based on such criteria. As soon as new meters are put on the market, they should be tested rigorously and reports of these tests should be made in the literature. As many of these meters are distributed freely by drug companies, the doctors who use these meters should know what the qualities of these meters are.

I fully agree with the editorial that “the ideal would be to obtain a single standard based on true scientific approach, which is satisfactory for both the ATS and the ERS.”

**Reference**

Editor’s comment

Having read the above letter from I. Gregg and the reply from H. Folgering, I fully support H. Folgering in his arguing that this paper is scientifically valid. What he did in his study was to compare the flow values shown on the peak flow meters with the values of a calibrated pneumotachograph. This is appropriate since all the tested meters claimed to measure the flow in L·min⁻¹. Whether the scale is equidistant, or nonequidistant, is of no relevance in such a comparison. The paper by Folgering et al. [1] underwent our regular peer review process. The responsible Associate Editor and two reviewers, all experts in the field, did not find that the study was flawed in this regard.

The problem is apparent: the old scale, the equidistant Wright scale, does not properly express the peak flow in L·min⁻¹, although it claims to do so. O.F. Pedersen, the first author of the editorial in this issue, suggested in a letter to me that a better term for the measured values of the equidistant Wright scale would have been "Wright units". If so, these values would not claim to show the flow in L·min⁻¹. But as long as meters claim to measure L·min⁻¹, comparison testing between them is justified, no matter what the scale looks like.

I also received letters from two companies, one from M. Sanders of Clement Clarke International, another from J. Cummins of Ferraris Medical Limited. In these letters, similar arguments as by I. Gregg were put forward. The letters were answered by H. Folgering directly, but space restriction did not allow printing of this lengthy correspondence. The only way to solve the scale problem in the future would be for manufacturers of peak flow meters to agree to a worldwide calibration standard with one accepted scale. As long as this does not exist, a comparison like the one done by Folgering et al. [1] is appropriate.

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