Calibrating the calibrators

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Serial measures of lung function are essential for the long term monitoring of chronic diseases such as chronic obstructive pulmonary disease (COPD) and pulmonary fibrosis where the main aim is to limit disease progression. Measures of forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) are generally the most reproducible and therefore suitable for long term disease monitoring. The annual decline in these parameters is about 30 ml/year in a normal person, about four times less than the short term variability of measurement. The main determinants of short term variability are patient/technician quality, spontaneous diurnal variation, and the effects of short term treatments such as bronchodilators. All of these can be minimised by good training, application of quality control protocols, and quality control audit. Much less emphasis has been placed on quality control for long term measurements for which equipment stability and linearity is essential. Several long term studies have run into problems despite regular calibration checks. Factors such as leaking mouthpieces, changes of electric cables between spirometer and computer, failure of the system to respond to temperature changes in the gas being measured, and non-linearity of the spirometer may result in errors of up to 200 ml, causing serious jeopardy to long term studies; the standard calibration checks supplied with the spirometers have failed to detect any of these errors.

In this issue of Thorax Dirksen and colleagues describe their experience with the Micromed turbine spirometer as used at home by 30 patients receiving 
\( \alpha_1 \)-antitrypsin augmentation treatment. They found more problems with their spirometer devices than with the spirometers. Each spirometer was checked for calibration monthly using one litre and three litre syringes and the Aarhus explosive decompression calibrator. Variability in individual spirometers was inferred when the standard error of the mean measurements from the 30 spirometers increased (readings from each two calendar months being pooled). A change in the mean value for each two month period was used to assess the stability of the calibration device. An abrupt change in the mean values was seen after the decompression calibrator was serviced with a change of FEV1 of 50 ml at one litre, with greater changes at FVC, suggesting a leak in the calibrator. In retrospect this could be detected by declining mean values of FVC from the calibrator over 12 months. There were also smaller (up to 30 ml) changes in volume from the two calibration syringes which were in opposite directions and thought to be due to a change in the speed of syringe emptying, unmasking non-linearity of the turbine spirometer.

These studies should lead to additions to our quality control standards. Calibration devices should be checked regularly for leaks and the same devices should be used regularly on a large number of spirometers so that problems with them can be separated from those due to the spirometer.

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