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Title: Validation of multiple-breath washout equipment for infants and preschool children

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Body: Introduction Verification of accuracy is required for multiple breath inert gas washout (MBW) equipment according to the new ERS/ATS Consensus Report. Aims To evaluate accuracy of two commercially available MBW setups in vitro using a new lung model, and to compare functional residual capacity (FRC) measured by MBW and plethysmography in vivo. Methods Two MBW setups, one for infants using sulfur hexafluoride (SF₆) and one for preschool children using helium, were evaluated in vitro in quasi-physiologic conditions with and without added carbon dioxide (CO₂). FRC was measured repeatedly for specific model settings, and corrected for additional CO₂ volume where appropriate. Difference of measured to model FRC and coefficient of variation (CV) per FRC were calculated for both in vitro setups. For in vivo evaluation, FRC values from helium MBW (FRC_{MBW}) were compared to those from plethysmography (FRC_{pleth}) in 20 healthy preschool children. Results In the infant model (51 runs, FRC 80 – 300 mL), mean (SD) relative difference was 1 % (5 %), mean CV was 4.9 % for measured FRCs. In the preschool model (50 runs), relative difference was up to 13 % in the lowest FRC setting (400 mL). For the remaining five specific FRCs (600 – 1400 mL), mean (SD) relative difference was – 2 % (3 %); mean CV was 1.6 % for measured FRCs. In vivo, FRC_{pleth} exceeded FRC_{MBW} with a mean relative difference of 38 % (1081 mL vs. 676 mL). Conclusion Both setups are appropriate for MBW in the respective FRC range (80 – 300 mL and 600 – 1400 mL). The surprisingly high difference of FRC_{MBW} and FRC_{pleth} in vivo remains unclear, but may be explained to some extent by physiological variability and differences in measurement technique.