A CALIBRATION FUNCTION FOR HANDHELD PM2.5 MONITORS IN DIESEL-POLLUTED ENVIRONMENTS

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Background and Aims: Handheld fine particulate matter ($PM_{2.5}$) monitors are increasingly used for exposure assessment due to the expense and lack of portability of reference methods. These handheld monitors have been shown to provide data that is not directly comparable to reference monitors. Although typically calibrated with dust standards (e.g., Arizona Road Dust), they are often used to measure particles dominated by compositions with different characteristics, such as diesel. Previous authors have attempted to determine a constant factor by which measurements of handheld monitors can be corrected. In urbanized areas where PM predominantly derives from diesel emissions, distribution of particle sizes differs from dust, and a constant calibration factor may not be appropriate. Instead, we derive a linear calibration function which more accurately represents the relationship between handheld and reference readings of diesel-related $PM_{2.5}$.
Methods: We collected data with co-located handheld and reference monitors simultaneously at sites contaminated with diesel PM in Boston, MA and Carlisle, PA. Handheld monitors were Sidepak AM510 (TSI Inc); references were beta attenuation monitors. Pilot data consisted of 80 hours (four monitor-days) of simultaneous measurements. Data collection continues during the summer of 2011.
Results: The Sidepaks read PM2.5 values substantially higher than the BAMs, consistent with previous studies. A linear calibration function was observed, ranging from about 1.0 at low $PM_{2.5}$, to about 3.5 at the highest PM2.5 levels (over 30 $\mu g/m^3$, twice the USEPA annual average standard), resulting in an excellent fit (R^2=0.8). Slopes and intercepts of each monitor-day regression were similar. A simple equation for a calibration function was then derived to correct Sidepak to BAM readings.
Conclusions: The proposed calibration function substantially improves correction of handheld monitor $PM_{2.5}$ data. In areas where transportation-related diesel contributes to PM, this provides more accurate PM measurements for exposure assessment and comparison with national standards.