Lean Data Analysis for Cascade Impaction Measurements

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BACKGROUND

Small particle mass characteristics are application-specific, particle size distributions (PSDs) are determined by a variety of techniques, and the details of these techniques can be found in the literature. This is a result of differences in aerosol research, testing or production environments, including therapeutic indications, device types, and patient respiratory habits. These differences can lead to difficulties in accurately characterizing aerosol size and concentration. A simplified data analysis approach (AIM) has been developed to address these concerns.

Application of the AIM Concept

The AIM concept is not based on a single measurement technique, but is a simplified measurement framework that leads to an estimated mean particle aerodynamic diameter (MMAD) and geometric standard deviation (GSD). The AIM framework encompasses a wide range of aerosol sampling techniques, including single stage and multi-stage cascade impaction, and can be used to calculate a ratio of large particle mass (LPM) to small particle mass (SPM).

Abbreviated Impactor Measurement (AIM) Concept

- **Simplified system** has intrinsically improved overall precision
  - Compared to current or no AIM-constrained Single Stage or cascade impaction to narrow mass (CIM) or Large particle mass (LPM) and small particle mass (SPM) for cascade impaction
  - AIM system can be reprogrammed to automatically adjust for minor changes in the test environment

Advantages of AIM Concept

- **Simplifies system** has chronically improved overall precision
  - Compared to current or no AIM-constrained Single Stage or cascade impaction to narrow mass (CIM) or Large particle mass (LPM) and small particle mass (SPM) for cascade impaction
  - AIM system can be reprogrammed to automatically adjust for minor changes in the test environment

RESULTS

The relationship between MMAD and R was approximately linear for every OIP type studied, as illustrated by the magnitudes of the correlation coefficients (see table below).

- The product of the slopes of SPIAD versus R, with R on the directly measured independent variable (MMAD), is approximately constant across all OIPs studied.
- The gradient of plots of MMAD versus R, with R as the directly measured independent variable (MMAD), is approximately constant across all OIPs studied.
- For each OIP, the relationship between SPIAD and R was linearly fitted to the equation: MMAD = aR + b, where a and b are the estimated slope and intercept, respectively.
- The MMAD versus R plots are shown below for each OIP type studied.

CONCLUSIONS

- Lean data analysis based on metrics derived from LPM and SPM should simplify development and QC during its commercial phase, while still remaining sensitive to critical quality attributes (CQAs).
- The proposed new data approach is based on the Abbreviated Impactor Measurement (AIM) concept, and is not a single measurement apparatus or specific way depending on the sponsor's data and agreements with regulators.
- NLM-8000 or AIMSP can be used to increase the performance of measurements through the reduction of data, as a potential step in a product development program, but it is the potential to save significant resources during both development and QC initiatives associated with uncompetitive OIPs.
- Furthermore, the AIM concept mimics near-term data analysis with fewer CQAs, but it can be used to improve the efficiency of near-term data analysis with fewer CQAs.
- The MMAD versus R plots are shown below for each OIP type studied.

ACKNOWLEDGEMENTS

The authors appreciate the ongoing support of IAPC-Reach for this project and technical advice from the European Pharmaceutical Industry Group (EPRIC).

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