A Personal Aerosol Sensor Platform to Link Children's Exposures to Asthma Severity

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RTI International with Charles E. Rodes, PhD, as principal investigator, will conduct two-pronged research to develop both a new technology aerosol sensing system, and a tiny but versatile, supporting personal platform to link both acute and chronic exposures to inflammation responses for asthmatic children. The sensing system development will focus on characterization of appropriately sized accumulation and coarse mode-sized aerosol utilizing multi-wavelength light scattering (micro-nephelometry). A tiny optical bench that is three to five times smaller than existing technologies will facilitate real-time characterization of residential particle scattering as well as allow estimation of the concurrent changes in endotoxin levels. The personal sensing system and platform combination will provide both real-time and integrated sample data in the same tiny package to characterize both acute and chronic exposures to specific aerosol sizes and particle-phase contaminants for both asthmatic children and adults. The system will provide real-time aerosol concentration level data to define peak exposure periods that can be linked to biological outcomes, as well as integrated particle collections that directly link the exposures to existing EPA $PM_{2.5}$ and PM_{10} standards - all in the same package. It will also include specialized contaminant collectors as part of the platform to address biological responses to known asthma co-factors and irritants, including ozone and environmental tobacco smoke (ETS). The underlying platform design and sensor package is targeted to be cell phone size and weigh less than 100g and will utilized programmable microelectronics to provide completely self-contained and self-deploying operation. It will collect and store full QC data in addition to sensor signals to provide data of known quality. It will also include a miniature motion sensor to assist in defining metabolic activity levels during exposures as well as protocol (wearing) compliance. Geospatial information will be collected using the latest technology GPS sensors. The design of the overall package will be optimized ("humanized") for children to be extremely low burden. This will also maximize the probability of being worn according to protocol.

The entire system (sensors and platform) will apply the latest micro-electronic systems technologies for sensor system control, data capture and communications. In parallel, RTI will develop procedures and supporting components that will facilitate (self) deployment of the personal sensor systems in subsequent large-scale respiratory diseases studies - especially those targeting childhood asthma. Applicable data validation and processing methods will be optimized to provide real-time and integrated sample data of known quality and representativeness. The performance of the sensing system will be validated using a limited cohort of asthmatic children in the RTP, NC area to illustrate the direct links between exposures

to asthma triggers (e.g. particle mass, endotoxin, ozone, ETS) and selected inflammation marker levels, including LTE4 and cotinine.

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