Volatile Organic Compounds in Exhaled Breath as Biomarkers of Pulmonary Exacerbations in Children with Cystic Fibrosis

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Background/Objective: Cystic Fibrosis (CF) is the most common lethal genetic disease in Caucasians, but CF affects all races and ethnicities. A characteristic manifestation of CF is the pulmonary exacerbation (PEx), which involves an increase in pulmonary symptoms, decrease in pulmonary function, energy loss, weight loss, and changes to clinical findings, and correlates with lung disease progression and lower quality of life. However, in children with CF, PExs have a subtle presentation, similar to that of the cold or flu, and there is a need for a test that can identify PExs. For this project, our objective was to establish a proof of concept for the use of volatile organic compounds (VOCs) in exhaled breath as PEx biomarkers.

Methods: This project enrolled 19 participants with a diagnosis of CF between the ages of 8 and 18, at Riley Cystic Fibrosis Center in Indianapolis. From each participant, exhaled breath was collected in a Tedlar Bag, in addition to lung function data and PEx status. Exhaled breath was analyzed for VOCs using Solid Phase Microextraction coupled to Gas Chromatography-Mass Spectrometry.

Results: There were 13 VOCs that exhibited statistically significant differences in concentration between exhaled breath at baseline and during a PEx. These VOCs could be used in a Principal Component Analysis to differentiate baseline and PEx conditions. Finally, using Linear Regression, this project identified 22 VOCs with a significant correlation to lung function, an important potential confounder. Limitations include: (1) comparisons of multiple VOCs increase the likelihood of a false positive result and (2) small sample size.

Conclusions: VOCs in exhaled breath are promising candidates as biomarkers to diagnose the presence and severity of PExs. In future experiments, we aim to expand the number of participants and track more clinical details to provide further evidence and applications for this proof of concept.