The Role of Breathomics in Respiratory Disease Research

BREATH BIOPSY®

Non-invasive, patient friendly sampling compatible with serial monitoring.

Proximal and accessible sampling of the respiratory system.

Breath sampling has the potential to enable decentralised clinical trials.

Pre-concentrates volatile metabolites increasing sensitivity.
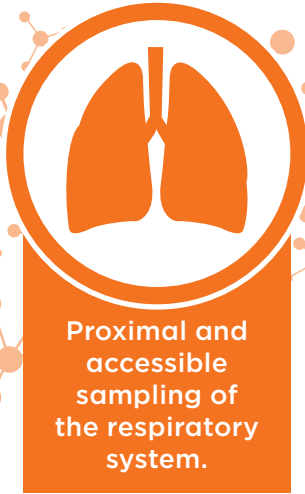
Find clinically relevant, non-invasive biomarkers for respiratory and other diseases:

Volatile metabolites are a non-invasive source of data proximal to the lungs, forgoing the need for invasive biopsy procedures to acquire biomarker information for lung conditions. These molecules provide an orthogonal dataset, complementing information from liquid metabolomics, proteomics, and genomics. This can be used to support characterization of novel phenotypes in complex diseases that could be targeted with drug treatments, and to support clinical drug development.

Breath Biopsy® is a non-invasive method of quantifying both endogenous and exogenous volatile metabolites on breath, enabling analysis of metabolites in the respiratory tract and other parts of the body via the bloodstream, including those produced by the microbiome. Breath can report not just on systemic factors but also biomarkers originating directly in the airways. Sample collection is safe, pain free and well tolerated by a variety of different patients, even those with breathing difficulties or reduced lung function.

Healthy Alveolus

Local cellular metabolism

Tissue uptake

AIR

Microbiome

Bloodstream
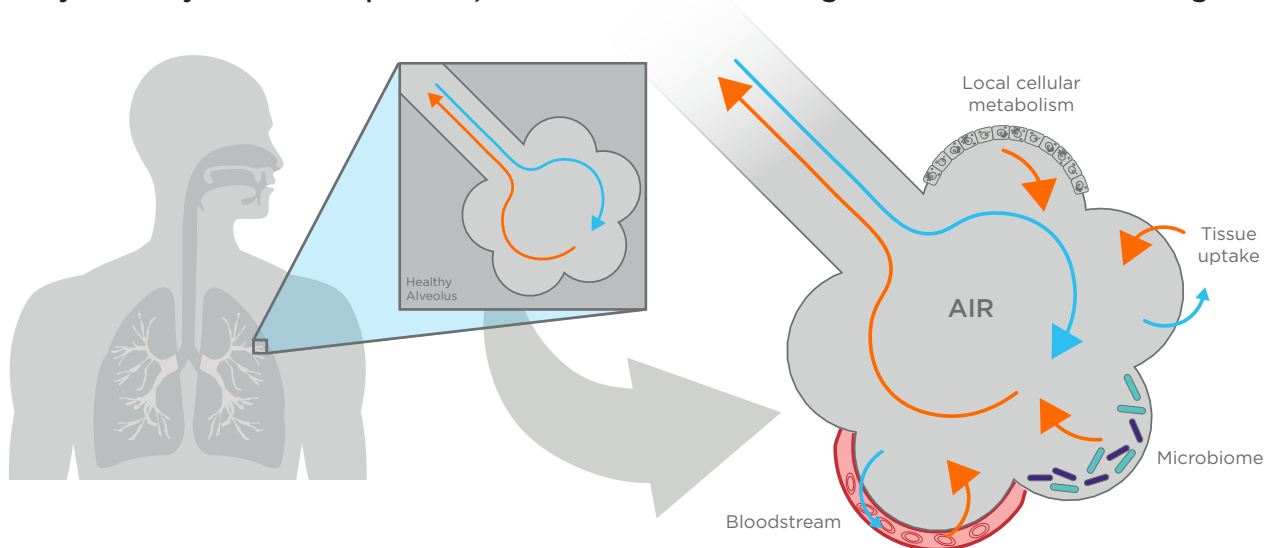
PRESENTATION - APPLICATIONS OF BREATH ANALYSIS: Use of longitudinal breath measurements at home in chronic respiratory patients, future or fiction?

Watch now to explore the future of clinical breathomics approaches to tackle respiratory diseases. Learn how infection can be detected with the help of VOCs in exhaled breath.

Case Study: Ibrahim et al., Science Translational Medicine 2022:

Several classes of volatile metabolites correlate with acute cardiorespiratory diseases, either being enriched or supressed when compared to healthy patients. These include hydrocarbons, carbonyls, aldehydes, ketones and sulphur containing metabolites.

101 volatile metabolites quantified and exhibited biomarker potential.

Differentiated asthma with an AUC of 0.88, COPD with an AUC of 0.86, heart failure with an AUC of 0.91, pneumonia with an AUC of 0.91 and healthy controls with an AUC of 1.0.

Multiple VOCs were found that have been previously reported in other breath studies. This includes: nonanal, decanal, hexanal, 2-pentanone for asthma, cyclohexane for pneumonia, and 2-3-butanedione for COPD.

Example VOC Generating Processes:

Lipid Peroxidation

Lipid peroxidation is a result of oxidative stress within cells, which can be caused by disease processes or immune responses such as inflammation. Lipid peroxidation is a chemical chain reaction between reactive oxygen species (ROS) and unsaturated fatty acids that results in the production of VOCs. The specific compounds produced depends on the structure of the fatty acids involved, and many of these VOCs have been proposed as candidate biomarkers in a wide range of diseases, including respiratory diseases such as asthma, COPD, PAH, pneumonia, tuberculosis and the respiratory manifestations of IBD.

Lung Microbiome

Pneumonia is a broad term for the symptoms caused by a number of pathogens – ideally rapid identification of the actual strain would allow prescription of targeted anti-microbial therapy. However, current techniques for determining the causative pathogen can be invasive and time consuming and any delay in treatment is associated with worse patient outcomes.

Previous studies have reported changes in the VOCs on breath of infected patients and suggested that the microbial volatilome could differ between strains. For example methylbutanal and 3-methylbutanoic have previously been associated with *S. aureus* in published reports in both *in vitro* and *in vivo* studies. This correlation suggests they they may share a microbial metabolic pathway of origin.

These distinctions mean that early detection of causative strains in diseases such as pneumonia and cystic fibrosis could be possible using breath VOCs.

Contact us to find out more about collaborating with Owlstone Medical and to discuss incorporating Breath Biopsy in your research.

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