## AI-POWERED DIAGNOSTICS

# Profiling Healthy Human Breath Using Artificial Intelligence

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Non-invasive diagnostic tools that could detect and alert to early exposure of an infectious agent or chemical threat would promote timely administration of appropriate therapeutics, reduce warfighter downtime, and improve warfighter mission readiness.  Breath is an attractive diagnostic sample for this type of application because it is non-invasive, fieldable, and contains signatures of host metabolic processes.  To detect off-normal breath characteristics most effectively, an understanding of the chemical components of exhaled breath from healthy individuals is needed.  Our goal is to help establish a baseline profile of normal healthy human breath biomarkers, which include both volatile and non-volatile constituents, with defined measures of statistical confidence.  To accomplish this objective, we are analyzing volatile organic compounds (VOCs) of breath and the exhaled breath condensate (EBC) from a longitudinal study of 240 healthy individuals.  In total, this includes over 1700 VOC samples (both human breath and background room air samples) and over 900 EBC samples analyzed by 2-dimensional gas chromatography mass spectrometry (GCxGC-MS) and liquid chromatography tandem mass spectrometry (LC-MS/MS), respectively. We use an artificial intelligence (AI) approach to identify breath signatures of individual data sources and evaluate if they are related to sample metadata and which variables are informative. Further, we use an AI integrative approach with sample metadata, VOC data, and EBC data to identify and quantify the probability of anomalous breath measurements. These results coupled with signature detection and feature selection with samples compared to random breath signatures are used. Finally, we look at these results compared to the use of single data sources (e.g. VOC data) and quantify the value added of multiple data types. This work will create a foundational understanding of the intra- and inter-individual variation in breath of normal humans, which will set the stage for more rapid and defensible breath diagnostics and fieldable device development.