CORONA VIRUS AND ASSOCIATED BIOMARKERS

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VOC FINGERPRINT

A non-invasive approach in identifying the Corona virus carrying individuals is based on the analysis of exhaled volatile organic compounds (VOCs) and biomarkers created by human metabolism while under sickness. In adults, several studies have independently shown that VOC can differentiate between patients with asthma, patients with chronic obstructive pulmonary disease and healthy controls[1]. In children with established asthma, volatile biomarker analysis enabled prediction of subsequent exacerbations[2]. A recent study[3] showed that children with preschool wheeze have different VOC when compared with their healthy counterparts. These results are likely to be driven by the association of VOC with inflammatory markers such as eosinophilia[4]. Based on these findings, an inflammatory response associated with Corona-induced wheeze should be detected by VOC analysis.

SAMPLE COLLECTION

For exhaled breath samples, a novel VOC Analyzer has been developed by Deep Sensing Algorithms Ltd (DSA). Patients blow into a sampling tube connected to the DSA Analyzer, the exhaled breath is subsequently sampled at 1 Hz for 30 seconds by the breath analyzer having an array of nanosensors with non-selective interactions with the VOC mixture. The analyzer creates a fingerprint like "breath-print" – of the tested individual based on the VOC composition of the exhaled breath gas. The sensor data is transmitted wirelessly to a secured data base at a server.

The VOCs targeted by the DSA Analyzer are derivatives of the biomarkers such as: Cardiac Troponins, C-reactive proteins, Cystatin C, D-dimer, Myoglobin, NT-proBNP, Procalcitonin, Human Serum Amyloid A, or Albumin.

DATA ANALYSIS

Data analysis is based on a Deep Computing algorithms developed by DSA. The handheld Analyzer uses local data nework to communicate with the cloud-based algorithm. The readings of the nanosensors are communicated to the algorithm that provides the diagnosis based on recognition of

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[1] S. Dragonieri, R. Schot, B.J. Mertens, et al., *An electronic nose in the discrimination of patients with asthma and controls*, J Allergy Clin Immunol 120(2007)856–862; N. Fens, A.C. Roldaan, M.P. van der Schee, et al., *External validation of exhaled breath profiling using an electronic nose in the discrimination of asthma with fixed airways obstruction and chronic obstructive pulmonary disease*, Clin Exp Allergy 41(2011)1371–1378.

[2] C.M. Robroeks, J.J. van Berkel, Q. Jöbsis, et al. *Exhaled volatile organic compounds predict exacerbations of childhood asthma in a 1-year prospective study*, Eur Respir J 42(2013)98–106.

[3] K.D.G. Van de Kant KDG, J.J. van Berkel, Q. Jöbsis, et al., *Exhaled breath profiling in diagnosing wheezy preschool childre*,. Eur Respir J 41(2013)183–188.

[4] B. Ibrahim, M. Basanta, P. Cadden, et al., *Non-invasive phenotyping using exhaled volatile organic compounds in asthma*, Thorax 66(2011)804–809; M.P. Van der Schee, R. Palmay, J.O. Cowan, et al., *Predicting steroid responsiveness in patients with asthma using exhaled breath profiling*, Clin Exp Allergy 43(2013)1217–1225.

the target VOC profiles. The algorithm is coded by using a machine learning artificial intelligence system trained to associate the sensor measurements to the VOC profiles associated with a particular set of biomarkers. In the launch version of the system, the algorithm is given an opportunity to re-regulate the nanosensors on the analyzer for optimized performance.

DSA ANALYZER

The DSA Analyzer allows probabilistic analysis and classification of subjects but is not intended to identify individual exhaled molecular constituents. The exact origins of the VOC differentiating symptomatic and asymptomatic individuals are unknown, but most likely result from a combination of airway obstruction, an increase in oxidative stress, changes in the microcirculation and the host's immune response. These compounds are likely to have both pulmonary and systemic origins. The Corona virus-associated VOCs are likely to be dependent on pathogen–host interactions.

The DSA analyzer can be used as a noninvasive measure of the host response to viral infection both during acute symptoms and thereafter. These expectations are in line with recent findings showing that exhaled biomarkers correlate with inflammatory sub-phenotype (sputum eosinophils) in asthma[5].

FIELD TEST IN FINLAND

A clinical test of the DSA COVID-19 Analyzer is carried out in June 2020 in collaboration with DSA and City of Helsinki Health Department for evaluating the performance of the DSA Analyzer, its sensitivity and specificity vs. Covid-19 infection. Both recently infected SARS-CoV-2 virus carriers and previously diagnosed patients with corona virus antibodies will be available for testing. The test cycle will be concluded by the end of June 2020. Additional tests are scheduled internationally.

THE DSA COVID-19 ANALYZER

The DSA COVID-19 Analyzer (Figure 1) is a system of gas sensors for detection and analysis of biomarkers found in gases released by humans that are used for identifying specific health conditions. A separate data leaflet is attached.

The analyzer generates predictions for different diseases based on deep learning algorithms trained by a number of test persons who are either healthy or diagnosed to have the disease in question (Figure 2).

The analyzer is a full-born IoT device and communicates with the cloud applications via a WLAN network identified by the user.

[5] B. Ibrahim, M. Basanta, P. Cadden, et al., *Non-invasive phenotyping using exhaled volatile organic compounds in asthma*, Thorax 66(2011)804–809; M.P. Van der Schee, R. Palmay, J.O. Cowan, et al., *Predicting steroid responsiveness in patients with asthma using exhaled breath profiling*, Clin Exp Allergy 43(2013)1217–1225.

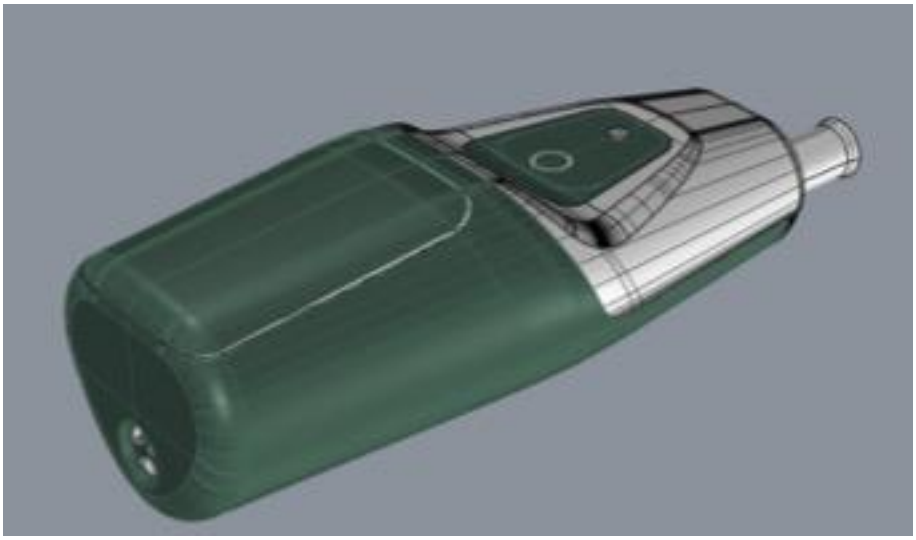

Figure 1: *The DSA COVID-19 Analyzer. The breath samples are given through a replaceable mouth piece (upper right hand corner), the outgoing air is filtered by a HEPA filter module (lower left hand corner). The device uses a local data network for communicating with the cloud applications.*