

## Biomarkers of diseases in human exhaled breathe

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Protagonists of medicine sincerely envisaged the living human body as the multifaceted permutation and combination of macro-molecule through assorted micro-molecules. So the internal environment at the micro-molecular level get in the way and reflects on its macromolecular casing leading away from the ease of life and health to disease. Unremitting technical advances throughout the last century spilling over into the new millennium empowered us with much awaited evidence stored in human exhaled breathe since last fifty years after Linus Pauling proclaimed that human breathe contained more than two hundred analyte. Later researches could reach to an estimate that, more than a thousand constituents with both volatile and non-volatile organic compounds are present in ever-changing quantities in breathe [1].

Presently, the breath researchers are using two forms of breath- exhaled breath and exhaled breath condensate. The former uses vapour phase molecules, while latter evaluates dissolved components after cooling breath to find varied elements. Breathe include elemental gases and permanent gases in health and disease; Nitric Oxide (relatively dependable marker of airway inflammation e.g. asthma, allergic rhinitis, eosinophilic bronchitis, COPD etc.); Carbon monoxide (increased in oxidative stress or stimulation by pro-inflammatory cytokines e.g. in smoking cessation programs, haemolytic jaundice in neonates etc.). Similarly, the aerosolized droplets in the exhaled breath condensate contain endogenously produced hundreds of nonvolatile compounds; ranging from the tiniest hydrogen ion to bigger molecules of dissolved proteins (pertinent to inflammation and oxidative injury, environmental exposure to Cobalt, Tungsten etc.). In addition there is a vast assortment of volatile organic compounds (evaluated as non-invasive

biomarkers of disease such as hyperlipidemia, lung cancer, exhaled aldehydes from the oxidative stress in heart disease, cancer, autoimmune and neurodegenerative disease, some infectious diseases, chronic fatigue syndrome, lifestyle related disorders and habits like smoking) [2].

More than a hundred different volatile organic compounds have been consistently detected in breathe; most abundant were Naphthalene, 1-methyl-, 3-heptanone, Methylcyclododecane, Heptane, 2,2,4,6,6-pentamethyl-, Benzene, cyclohexane; Monomethylated alkanes viz. dimethylcyclohexane, methylheptane, methylcyclododecane, and tetramethylbenzene have also been identified in the patients suffering from pulmonary tuberculosis. Commercially available analyzers can measure Nitric Oxide levels in parts per billion and even carbon monoxide to the parts per million levels. These breath biomarkers are noted to be quite selective to provide an accurate, rapid, inexpensive and non-invasive diagnostic and prognostic method. In small cell carcinoma the use of colorimetric biosensor has provided encouraging results. In active pulmonary tuberculosis, tests have been able to differentiate sputum positive or negative cases; notable elevated levels in active spells and reduced with therapy; even biomarkers in breath and in sputum cultures were comparable [2-6].

With the collaboration between technical, medical, and commercial professionals, the foremost innovations in novel technologies (infrared, electrochemical, chemiluminescence, and others) with precision mass spectrometers has made considerable impetus in the field of breath analysis. Researches are

ongoing using various approaches like Isotopic ratio mass spectrometer, Ultraviolet absorbance spectrometer, Gas chromatography/ mass spectroscopy, Polymerase Chain Reaction amplification, Immunosensor, Bio-optical technology, Colorimetric responses and other methods to detect volatile organic compounds [1-2, 6-12].

To sum up, a sincere urge for rapid transitioning of research findings from the bench-side to the bedside is a relatively new development in the health care arena. Over the last decade, there have been significant technical advances allowing new technological devices to be in user friendly. Several diagnostic methods have either established or are about to enter inside routine clinical practice; breathe alcohol concentration (BAC) is in regular use by cops in several countries. With this charisma of medical science, researchers in the health care internalized the eternal symphony of life, though medicine is a para-science based on the basic tenet of physics, chemistry and mathematics hidden in the organ-systems. If we can capture and analyze thousands

of molecules expelled with each breath, we hope to make out a signature pattern comparable to biometry to provide useful information in health and disease [13-14].

As the soldier in the health care science we need to join the hands together to bring together all the scientific principles for a holistic goal. The researchers in different part of the globe are working on qualitative and quantitative data analysis of potential disease biomarkers. Future directions of studies will have to aim at the applications in health care area in the diagnosis and prognosis with dynamic evaluations of normal physiological function or pharmacodynamics of exhaled breathe biomarkers. International Association of Breath Research (IABR) has been established to have a platform for researchers in the field with an annual meet for exchange of knowledge with the Journal of Breath Research (JBR) as the official publication of the IABR.

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**Editor's note;** Prof. Ranabir Pal is a noted expert in public health and an Editorial Board Member of Al Ameen Journal of Medical sciences.