Pulmonary arterial hypertension (PAH) is a relatively rare but very serious disease associated with abnormally high tension in the pulmonary arteries. As blood circulates through these vessels, the oxygen gets into it. The causes of the disease are varied. These can be congenital heart diseases, connective tissue diseases (such as scleroderma), liver disease, HIV infection. Sometimes the cause is uknown. Mechanisms of the disease development are not fully understood. The symptoms are non-specific. Most often patients suffer from progressive fatigue, breathing difficulties, dyspnoea during effort and, when the disease is more avanced, also from cough, chest pain, hemoptysis. As the symptomes mentioned above may be present in many other conditions, pulmonary hypertension is often diagnosed when the disease is already advanced.

The aim of the project is to broaden the knowledge about this important disease - mechanisms of its formation, metabolic changes, changes in the composition of the exhaled air. Finding the specific characteristics of the disease in the blood or in the exhaled air will probably also allow to design the screening tests, ie low-cost tests that can be performed cheaply, quickly and safely. This would in turn allow to diagnose the disease earlier and to start appropriate treatment, what is extremely important, because it allows to significantly prolong the life of the patients, including life with wellbeing.

To assess the aforementioned changes, including finding biomarkers, ie indicators of PAH, the analysis of the exhaled air will be used – fast, screening method that has already been examined in the diagnostics of upper respiratory tumors - both the high sensitivity of the respiratory sorption method on the highly porous material and the very high threshold for the detection of tumor markers have been confirmed which during the statistical analysis have been correlated with specific disease unit. The innovation of the method consists in the complete elimination of the imperfect due to microbial activity and large volume tedlar bags and replacing them with a proprietary patented porous material embedded in a two-way mouthpiece, which allows simultaneous collection of background air along with the characteristic bacterial flora of a given room and the patient breathing air. After subtracting both results from each other, a composition of the respiratory phase is obtained with the filtered background material from the room in which the patient's respiratory phase was taken. This allows to compare breathing phases collected not only at different times but also in rooms with different microbiological profile. Such exhaust phase absorbed on a given porous sorbent material is then sent to a laboratory, where is then evaluated in terms of molecularity with the use of GC MS technology and surface-to-surface analysis. In order to validate the method, blood samples will also be collected from each patient and then will be screened for high performance liquid chromatography markers. Such combination of methods is not only characterized by the incredible speed of the test but also by the sensitivity to microbiological markers at several pico-gram levels. In addition, due to the specificity of chromatography tests conjugated with spectral techniques it is impossible to obtain the false positive results. False negative results are only obtainable if the concentration of markers is below the detection limit of the apparatus. Due to the use of two techniques it is possible to quickly validate the obtained result and to correlate one another.

The described research methods will allow to identify changes in the human body connected with pulmonary arterial hypertension, which will translate into a better understanding of this disease, including the mechanisms of its development. This knowledge will also enable potential screening tests to be developed. These in turn would allow a very early diagnosis of pulmonary arterial hypertension. This methodology of reasearch is likely to be used for other diseases as well. It can also serve as a method supporting classic examinations in cases where standard techniques do not give unambiguous results.