Second wind: New technology to help diagnose and manage respiratory diseases

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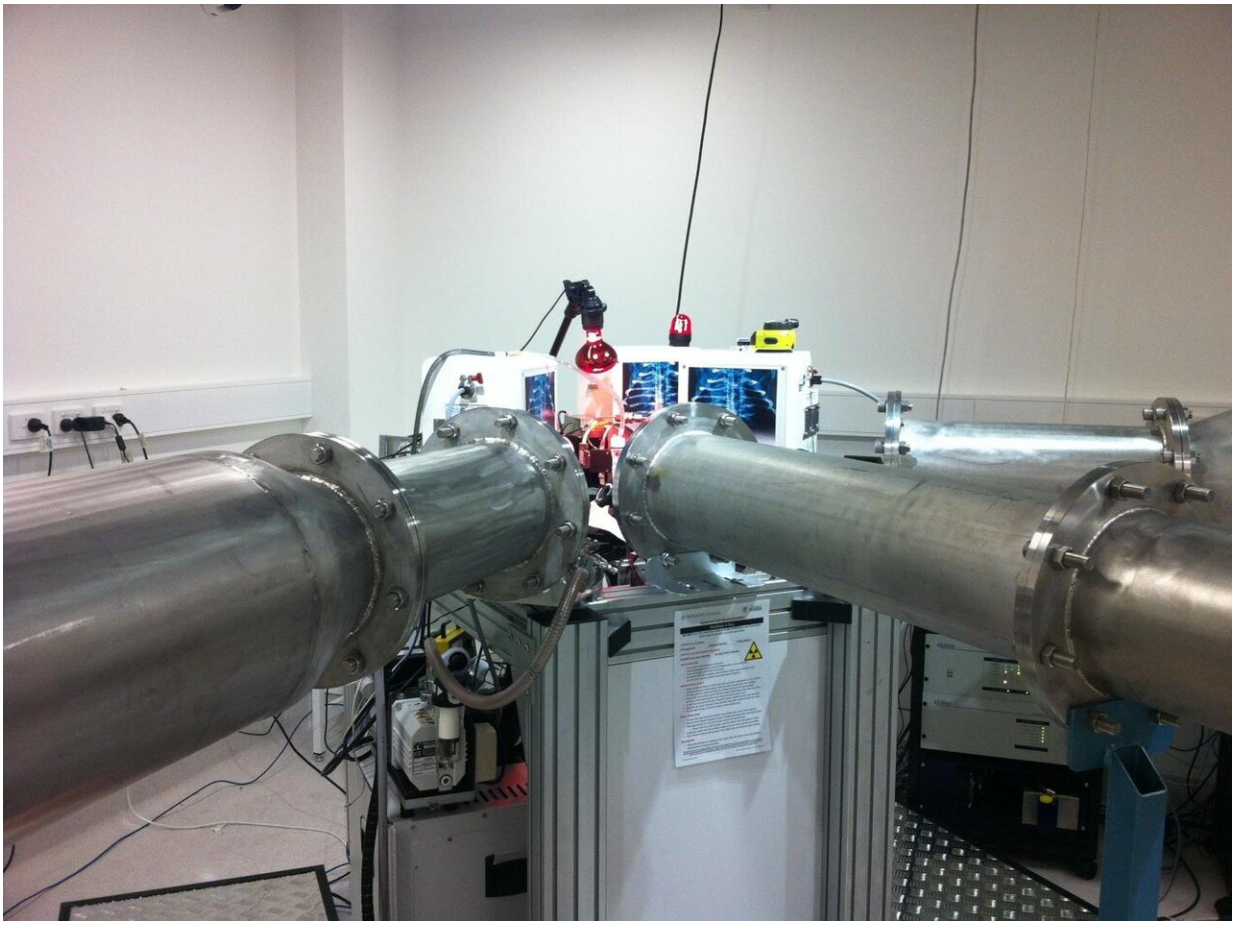


Technology in use Credit: Monash University

Monash University researchers in Australia have developed radical non-

invasive technology that can be used to diagnose respiratory lung diseases, such as cystic fibrosis and lung cancer, and potentially fast-track treatments for patients.

Researchers have for the first time taken technology usually confined to high-tech synchrotron facilities into a common laboratory setting, and applied new four-dimensional X-ray velocity (XV Technology) imaging to provide high-definition and sensitive real-time images of airflow through the lungs in live organisms.

The study, led by Dr. Rhiannon Murrie from the Department of Mechanical and Aerospace Engineering at Monash University, shows the likely impact this technology has in respiratory disease detection, monitoring and treatment through non-invasive and non-terminal means.

The technology also has the potential to see whether treatments for respiratory illnesses are working much earlier.

The technology has since been commercialised by Australian-based med-tech company 4Dx Limited, led by CEO and former Monash University researcher Professor Andreas Fouras. The technology has been upscaled for human clinical trials taking place in the USA, with Phase I already completed successfully.

The study was published in *Scientific Reports* in January 2020.

"The early diagnosis and ongoing monitoring of genetic and chronic lung diseases, such as cystic fibrosis, asthma and lung cancer, is currently hampered by the inability to capture the spatial distribution of lung function in a breathing lung," Dr. Murrie said.

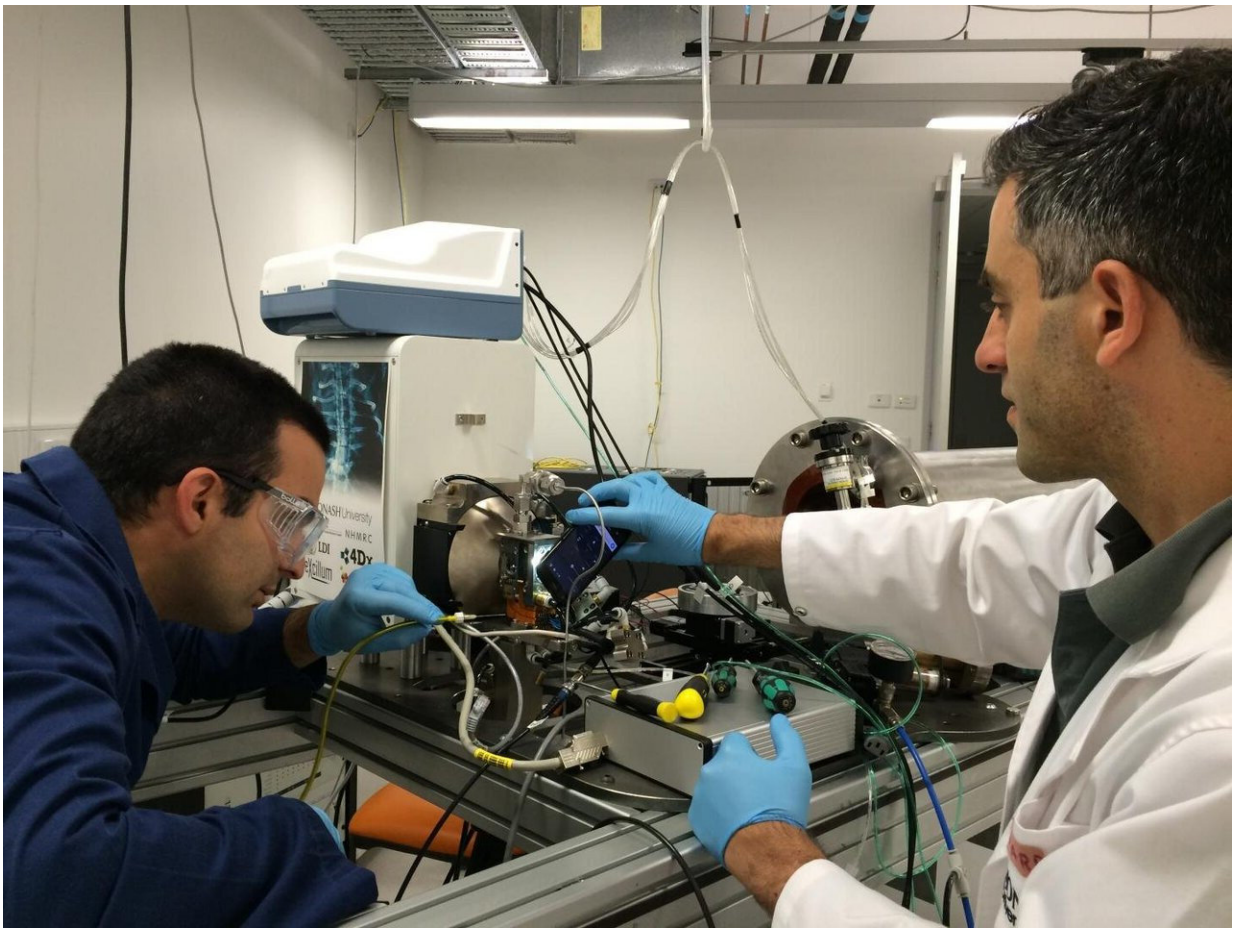
"Since pulmonary function tests are measured at the mouth, these tests are unable to localise where in the lung any change in function

originates. Additionally, CT scans, while providing quality 3-D images, cannot image the lung while it is breathing, which means airflow through the airways and into the lung tissue cannot be measured."

Research by Dr. Murrie and the multi-disciplinary collaboration of physicists, engineers, biologists and clinicians are changing this approach to the diagnosis and treatment of lung diseases, by determining the functional lung movement and airflow in live mice, acquired through X-ray technology at 30 frames per second.

A comparison of a cystic fibrosis mouse model against a healthy control mouse allowed researchers to observe a dramatic reduction in lung aeration in the left lung of the diseased mouse largely due to an obstructed airway path.

Researchers were able to pinpoint the exact locations where lung deficiencies were present and the location of the obstruction causing the restricted airflow.



The successful trial opens up avenues for respiratory diseases to be diagnosed, treated and managed earlier than current technology allows and at a lower radiation dose than current CT scanning.

"The ability to perform this technique in the lab makes longitudinal studies on disease progression and treatment development feasible at readily accessible facilities across the world," Dr. Murrie said.

"This finding is an exciting step in advancing the understanding of lung

diseases and treatments that affect millions of people globally, and particularly for those with cystic fibrosis, which affects more than 70,000 people worldwide."

Professor Fouras said: "I am pleased to see this technology, originally developed at Monash University, and now being commercialised to maximise clinical impact, also enabling cutting-edge medical research like this."

More information: Rhiannon P. Murrie et al, Real-time in vivo imaging of regional lung function in a mouse model of cystic fibrosis on a laboratory X-ray source, *Scientific Reports* (2020). DOI: 10.1038/s41598-019-57376-w

Provided by Monash University