Spirometry:

Parameters: FEV (Forced expiratory volume)

Definition: the volume of air that an individual can exhale during a forced breath in t seconds

Limitation:

* measure of the health of the entire lung
* effort-dependent
* provide no information about the location of muco-obstructive disease

Parameters: lung clearance index

Definition: the number of lung volume turnovers needed to reduce the concentration of a tracer gas by a factor of 40 with tidal breathing

Limitation:

* limited regional airflow information

Parameters: Forced oscillation technique

Definition: a non-invasive method to assess airway function by emitting oscillatory signals into the respiratory tract during tidal ventilation

Limitation:

* single whole lung parameters

**they cannot accurately localise the changes in airflow that are caused by structural abnormalities within the lung.**

CT provides excellent structural information

Limitation: cannot prevent the disease establish until it causes structural changes

MRI

Limitation: poor spatial resolution

**none of these are able to simultaneously identify the origin of changes in function, and evaluate their heterogeneity.**

Abnormal lung motion during breathing has been demonstrated to be an indicator of disease

Propagation-based phase-contrast X-ray imaging (PCXI)

PCXI can be combined with tomography to create detailed three-dimensional reconstructions of the fine structures in the lungs20–23. Using multiple PCXI images acquired throughout the respiratory cycle, Fouras et al.16 applied particle-image velocimetry to determine the speed and direction of lung motion in three dimensions throughout the respiratory cycle.

This high-speed PCXI acquisition and post-processing analysis is termed X-ray velocimetry (XV)

**XV assesses the dynamics of the lung tissue movement throughout the breath in order to extract measures of tissue expansion**

**Result of XV:**

A detailed ventilation map

enables the volume of air that flows through each branch of the lung tree to be calculated

**lab apparatus:**

synchrotron-based X-ray source

access spatial and temporal variability of airflow

**Medicine:**

* In medical research, heterogeneity can be observed in the response of individuals to a particular treatment or drug. Patients may vary in their physiological responses, making it important to consider and understand this diversity in treatment outcomes.