

Respiratory Tract Diseases



Research on human diseases relies extensively on animal models, however, effective new therapies for serious respiratory conditions are still lacking.



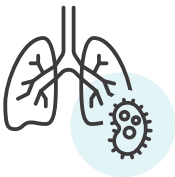
Reliance on animal models is failing to identify novel therapies, because they often poorly represent human physiology and pathology.



Research is shifting towards **sophisticated bioengineering** approaches that better recapitulate lung development, anatomy and physiological functions in cell-based (in vitro) systems.



The development of lung-on-a-chips microdevices allow the reconstitution of the most relevant architecture and functions of living human organs.



Lung organoid culture systems are ripe for development in disease modelling and treatment.

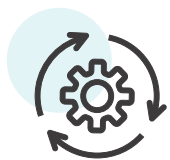


A "breathing lung-on-a-chip" microdevice recreates physiological breathing movements.



The emerging use of more human-relevant models, e.g. 3D human tissue cultures, spheroids, organoids, and microfluidic / 'lung-on-a-chip' systems shows immense promise for the development of model systems that more accurately mimic human respiratory diseases.

BIOLOGICAL QUESTIONS AND TECHNICAL CHALLENGES TO BE OVERCOME:



Systematic approach to elucidate the mechanisms that control differentiation of specific cell lineages in vitro, allowing more controlled tissue engineering and translational applications of human pluripotent stem cells.



Integrate the proximal (airway) and distal alveolar compartments of the lung into a single, reproducible model.



Growing complex tissue / organoids in a well-defined physical environment.



Development of modular **'human-on-a-chip systems'**, integrating an entire respiratory tract on a chip, incorporating nasal, upper airways and lower airways chips.



The generation of patient-derived **organoids from biopsies** will provide powerful research tools for a wide range of translational and medical approaches, such as drug efficacy and toxicity studies.



Standardisation of all aspects of culture in organoids and lung-on-a-chip technologies to be used as disease surrogates.



Future developments

in this area require the nurturing of a multidisciplinary approach, requiring cooperation between disease focused biologists, bioengineers and mathematical modellers, so as to develop an all-encompassing understanding of how the structural environment of the lung relates to normal and diseases states.