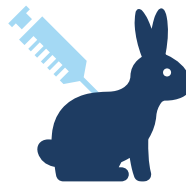


Neurodegenerative diseases



Neurodegenerative diseases have been the subject of intense research efforts but so far, **existing therapies are very limited** and only treat the symptoms.



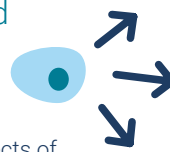
Animal-based models are extensively used in research, yet neuroprotective drugs have failed in human trials suggesting that these models **poorly represent human physiology and pathology.**

Recently, **advanced non-animal methods that better address the human-specific features** of neurodegenerative diseases have been developed to generate new insights into disease mechanisms and drug development.



Human-induced pluripotent stem cells

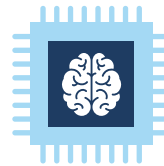
can be used to better reproduce some aspects of neurodegenerative diseases and offer potential for cell replacement therapies.



Unique tools for **proteomic analysis of 3D neurons and brain tissue** from patients affected by neurodegenerative diseases contribute to more precise diagnoses.

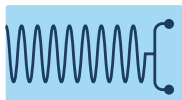


Most in silico models are standardised and highly focused on the investigation of disease and its mechanisms, offering great potential for replacing animal-based models.



Microfluidic 'brain on chip' technologies are extensively used for disease diagnosis and investigation of disease mechanisms, and show promising developments for therapy and drug development and testing.

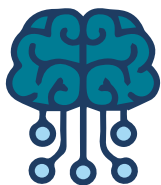
FUTURE DEVELOPMENTS



Microfluidic devices can be optimised for the identification of biomarkers in clinical settings and as tools to monitor disease progression.



Human/patient-derived primary or stem cell models need further development to contribute to disease therapy and drug development.



Standardisation and validation of 3D models to study disease features can lead to models that better mimic the physiological, structural and molecular characteristics of the central nervous system.



Organoid models should be further developed and optimized with a major focus on the neuronal degeneration of dopaminergic neurons as well as on protein aggregation to accelerate drug and therapy development.



A standard method to develop realistic **in vitro blood-brain barrier models** is needed to investigate pathogenic mechanisms and for therapeutic exploration.



A more comprehensive framework merging together computational technologies with advanced human-based in vitro models will drive progress in the field of neurodegenerative diseases and will bring the prospect of personalised medicine another step closer.