# Brain-on-a-chip technology to develop precision medicine for brain disorders

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Nadif Kasri Lab

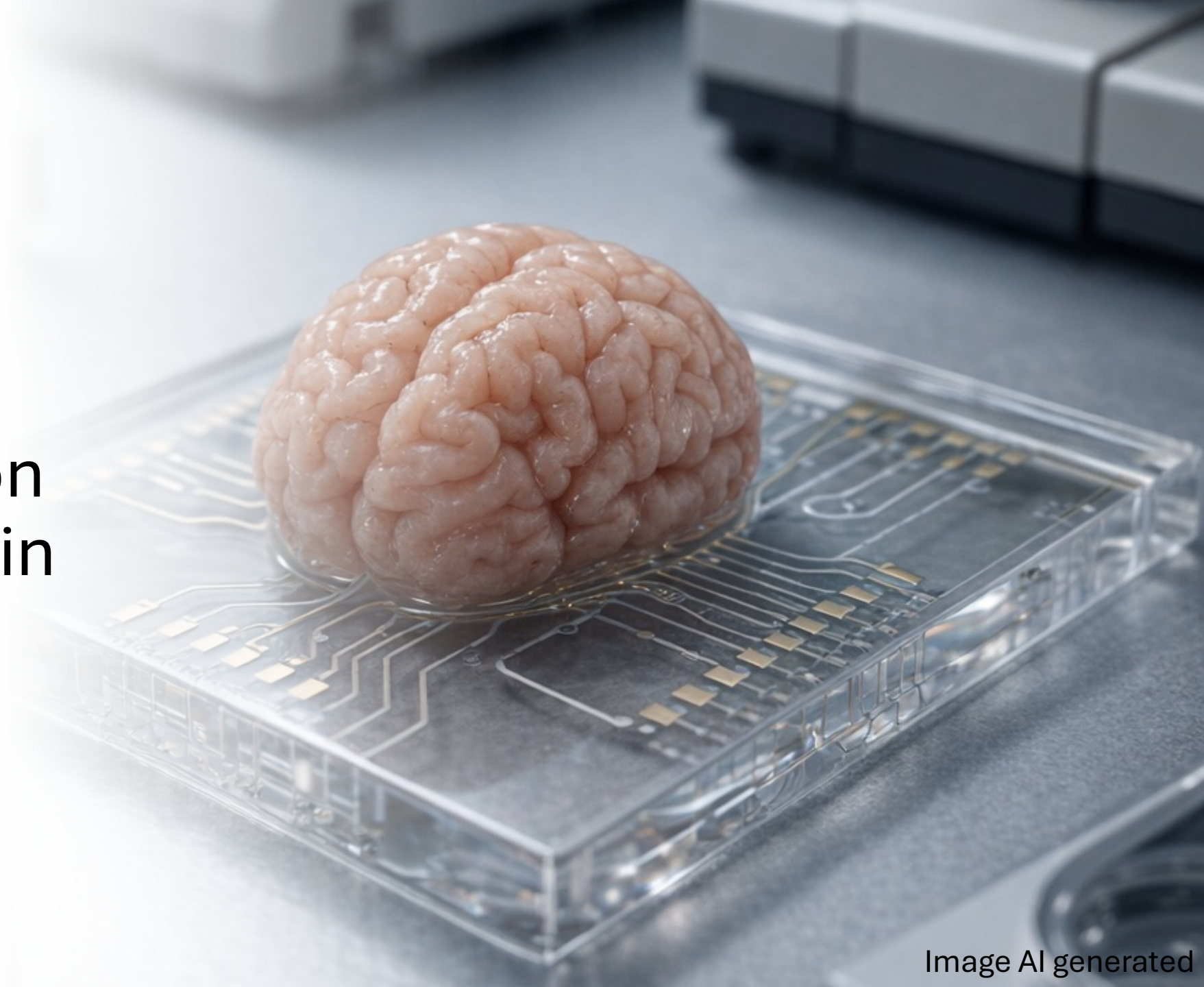


Image AI generated

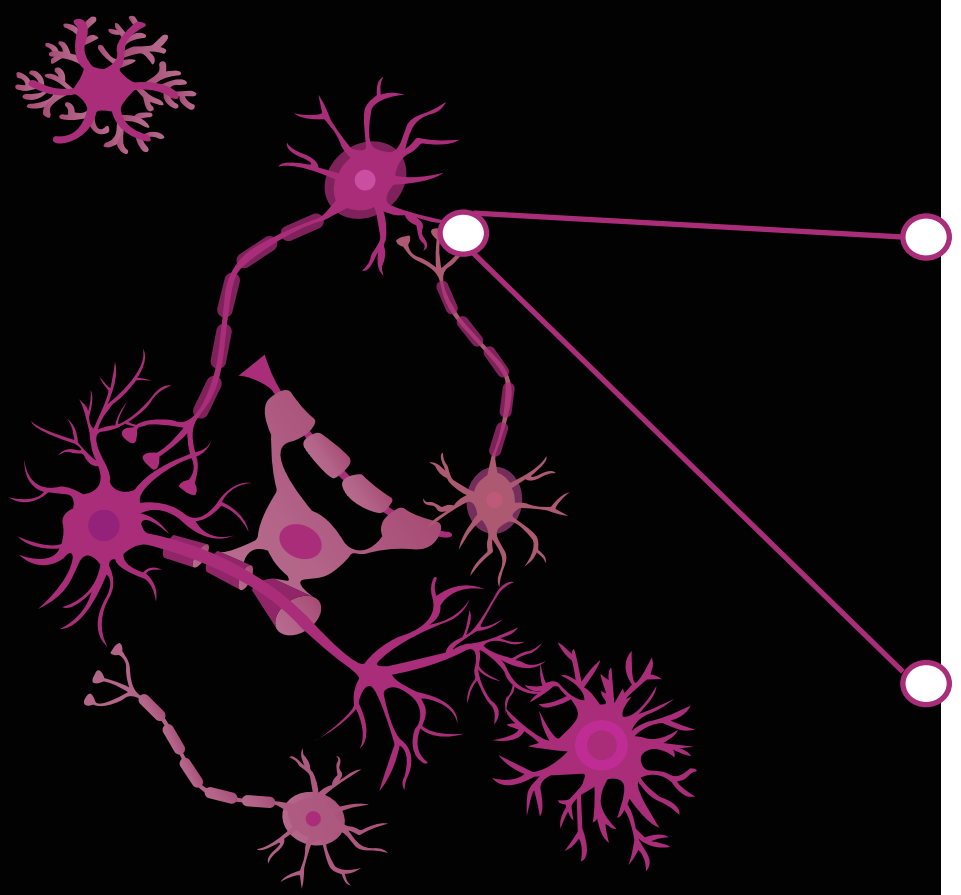
# Traditional drug development pipeline


*“The good physician treats the disease; the great physician treats the patient who has the disease” - William Osler 1849-1919*

*Father of Modern Medicine*

## NETWORK

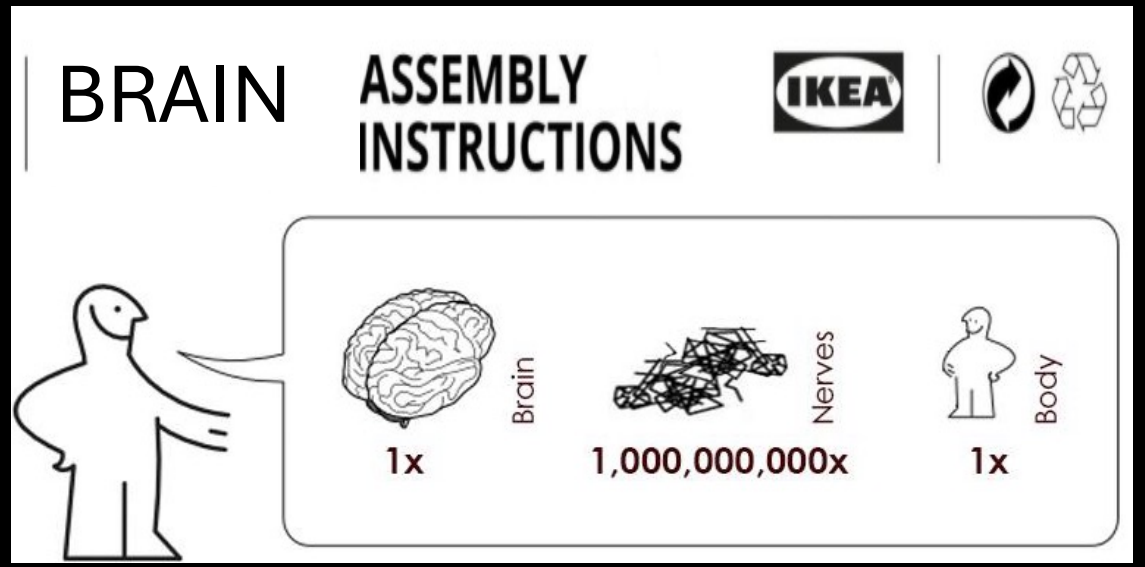
- *86 billion neurons*
- *250,000 neurons per minute*



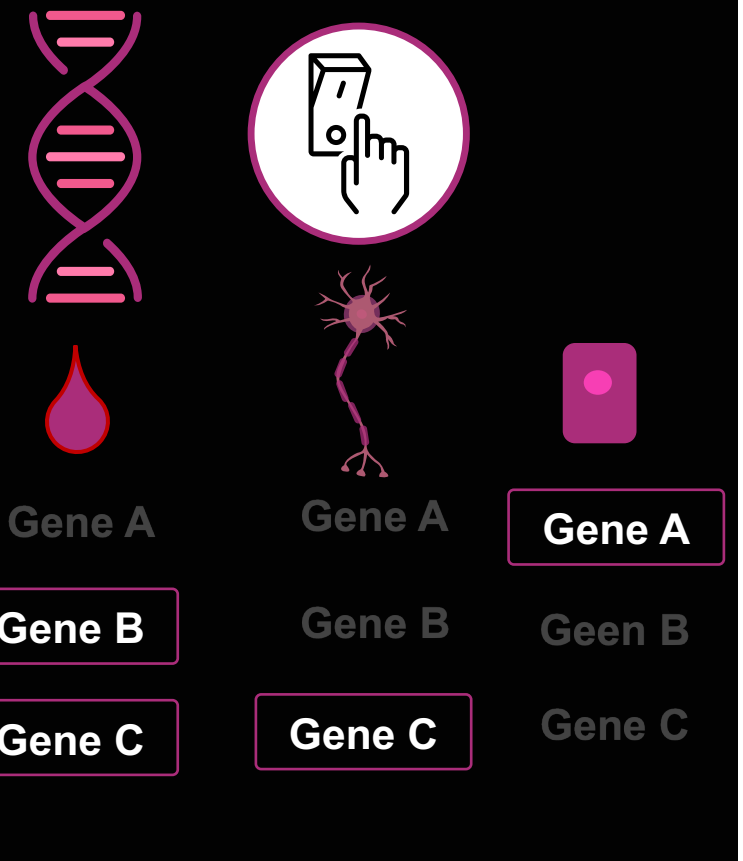
## SYNAPS

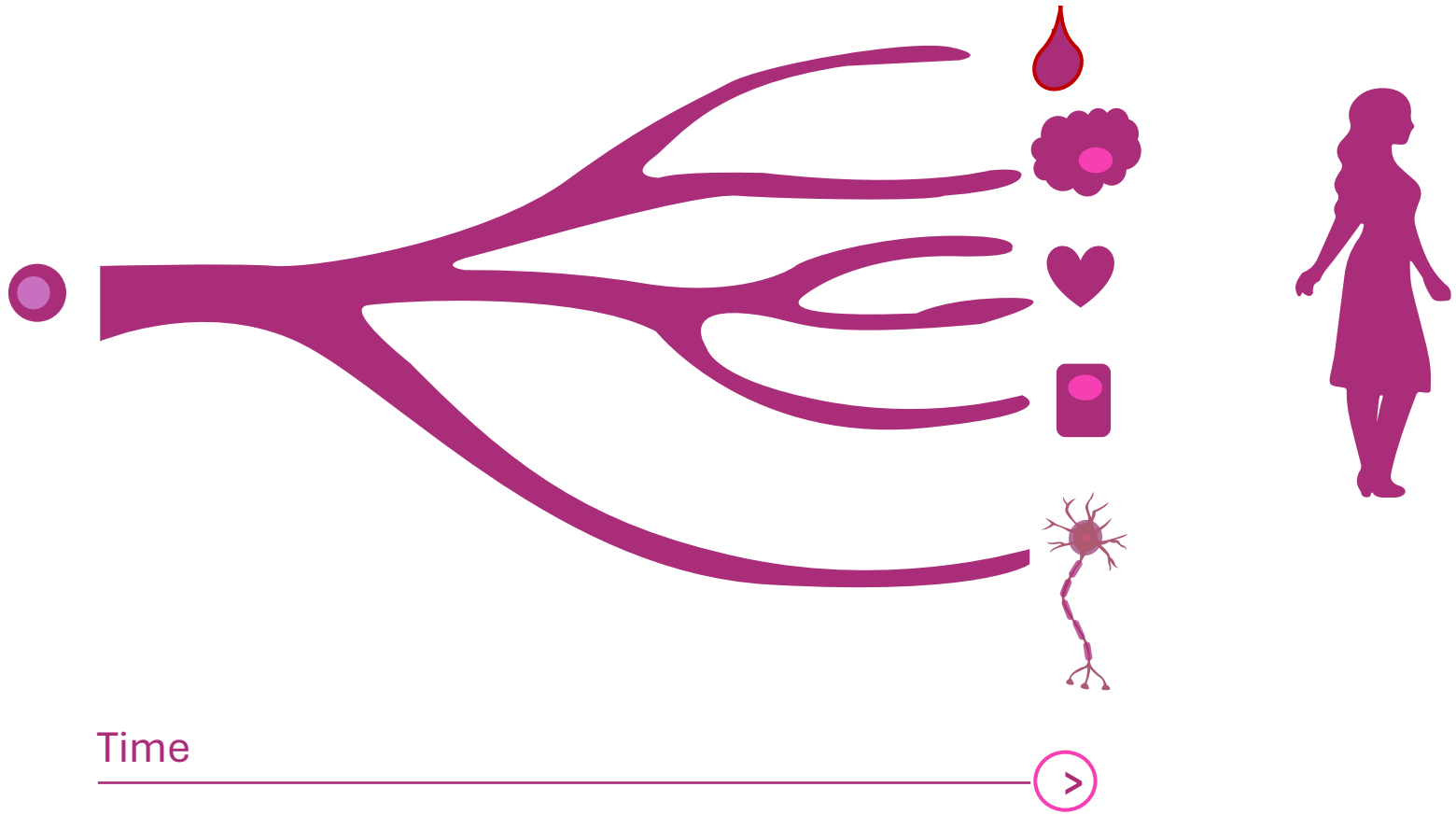
The human brain is complex and not accessible

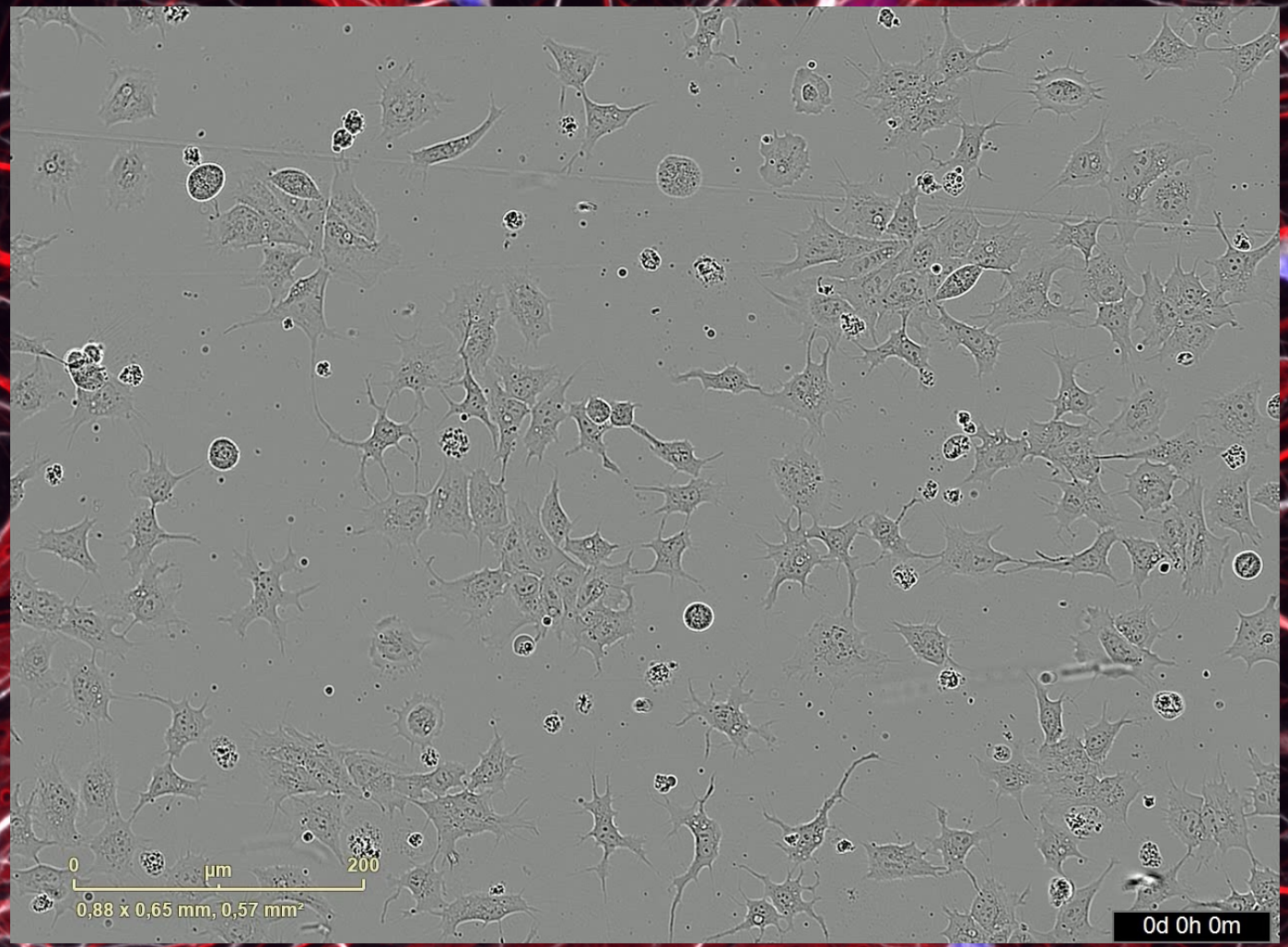
Better understand the brain by assembling it … in the lab



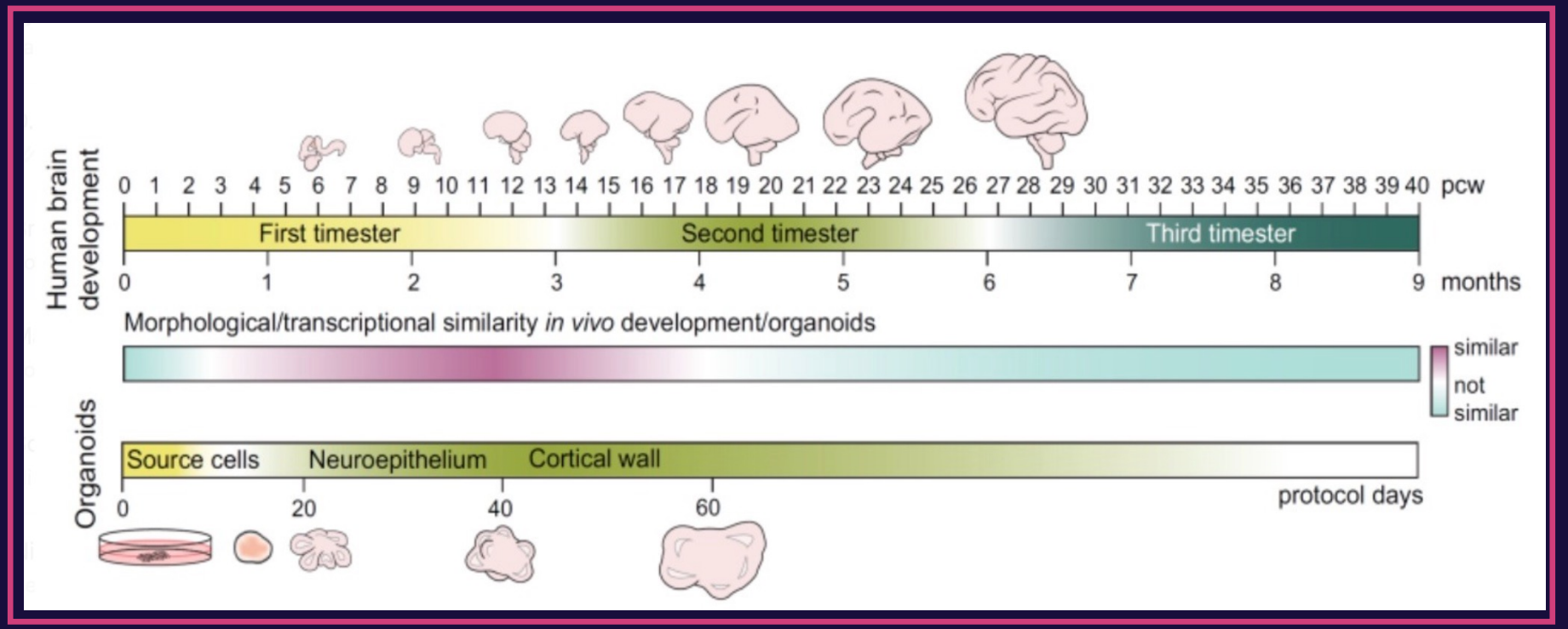
# Cellular time travelling: Stem cells

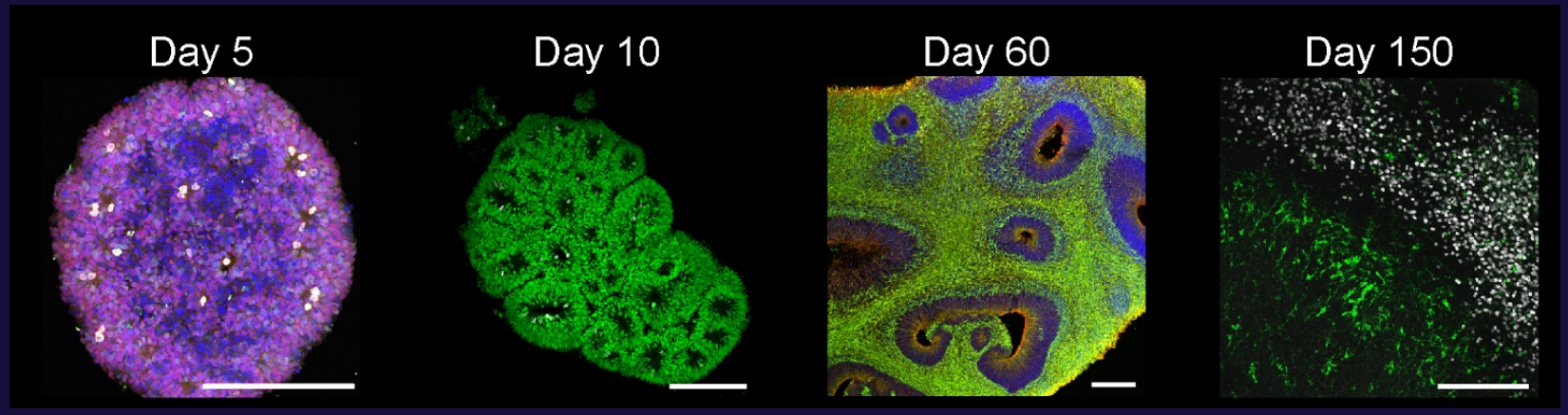


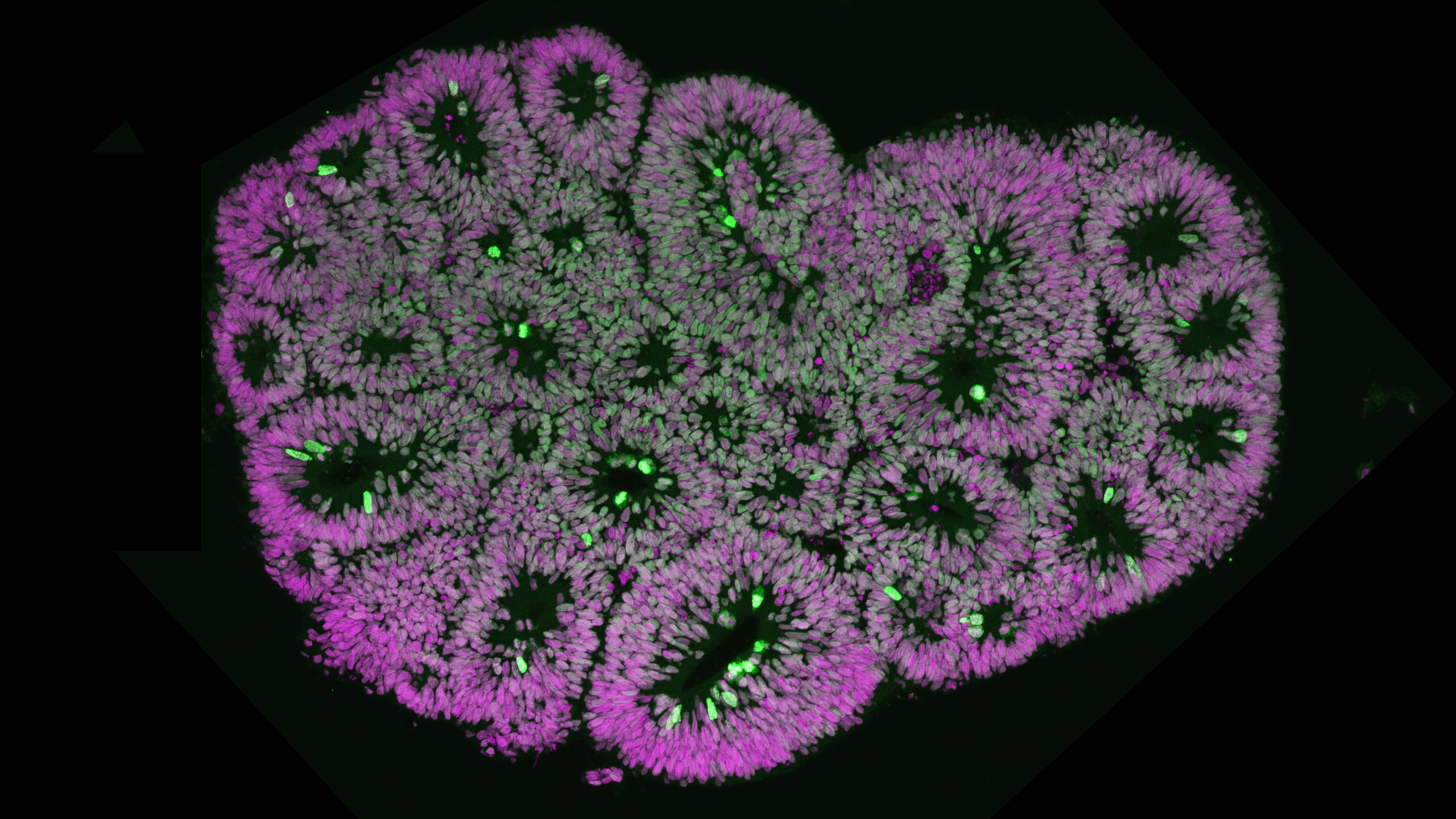



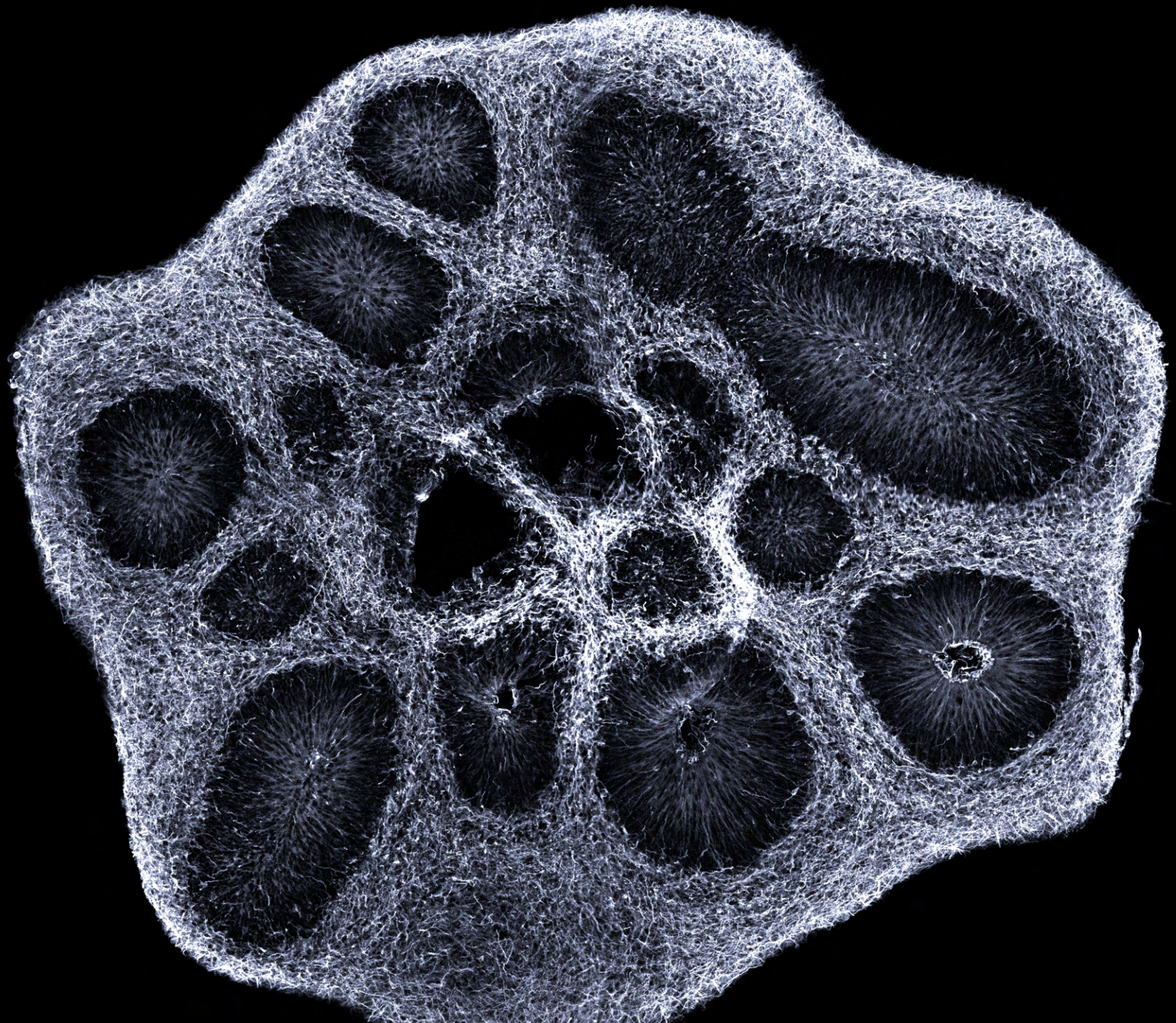

0
µm
200
0,88 x 0,65 mm, 0,57 mm²
0d 0h 0m

# Brain organoids follow a developmental trajectory reminiscent of human brain development

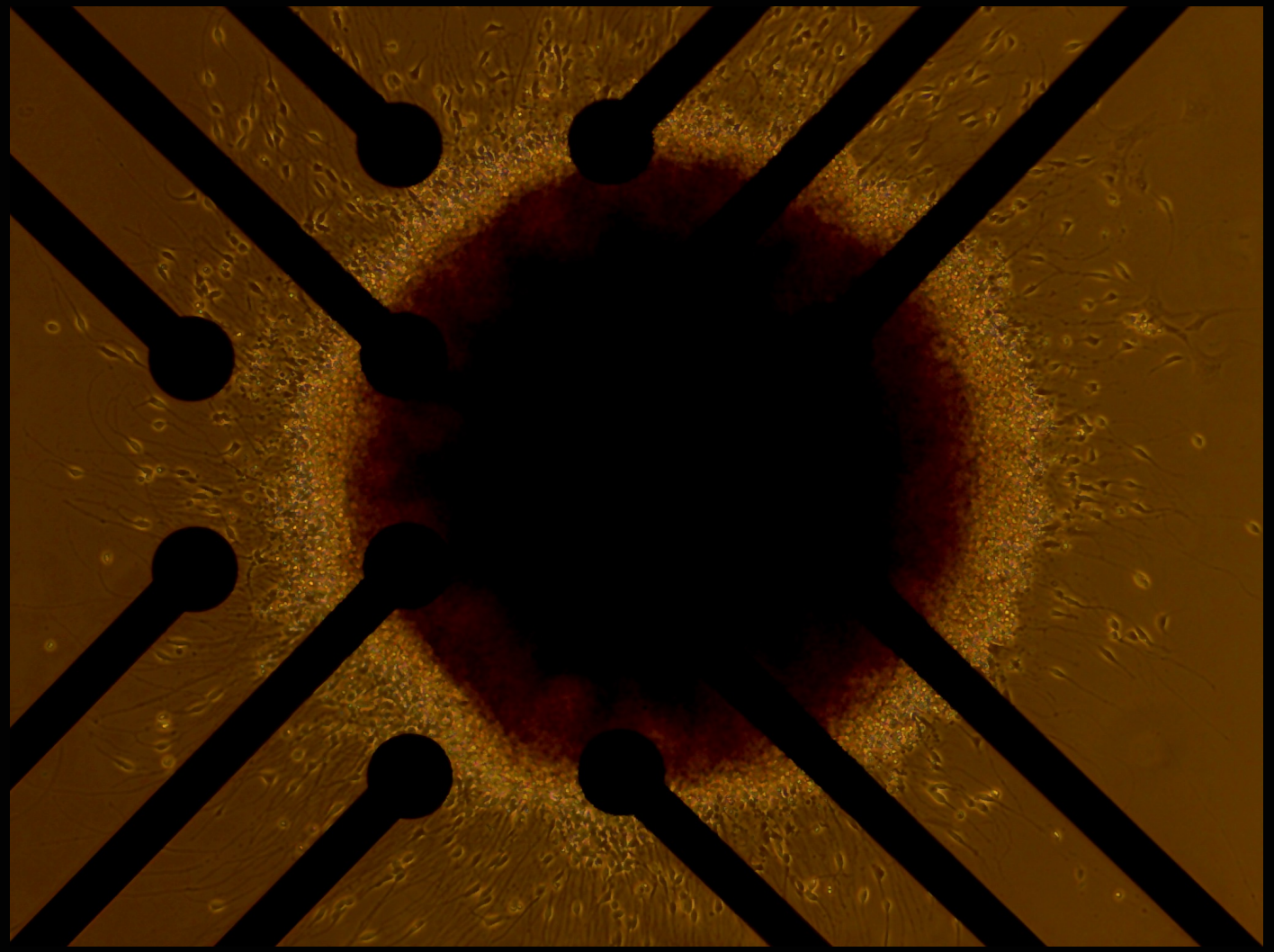


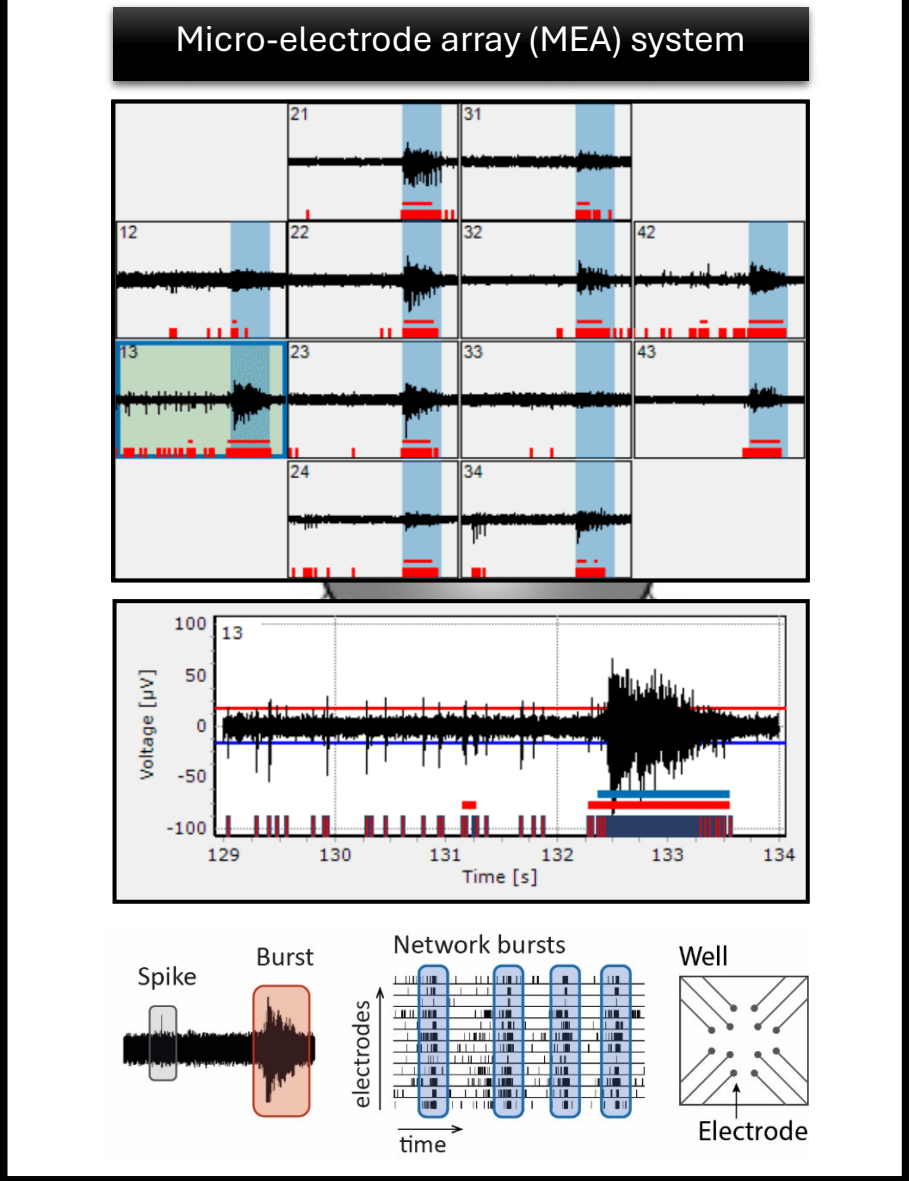





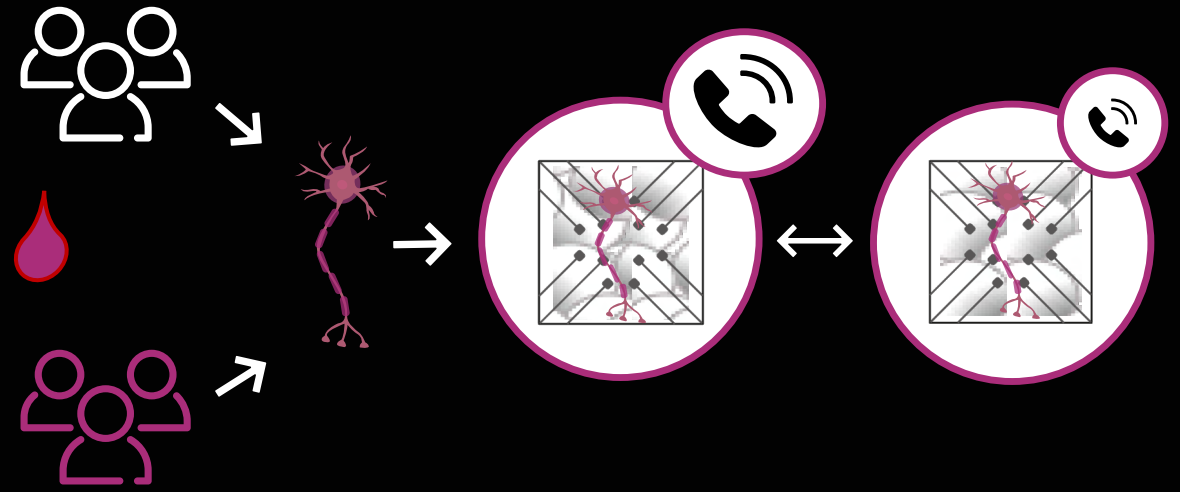


# Cerebral organoids on a chip: Micro electrode Arrays



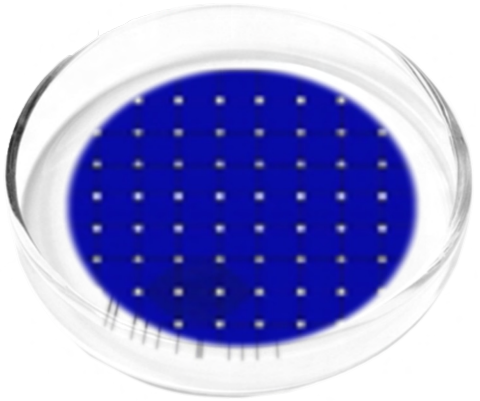


# BRAIN-on-a-CHIP
# TECHNOLOGY



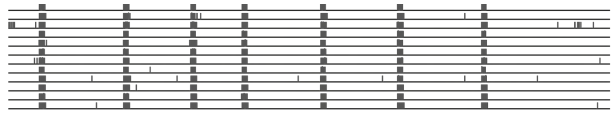
When?

How often?

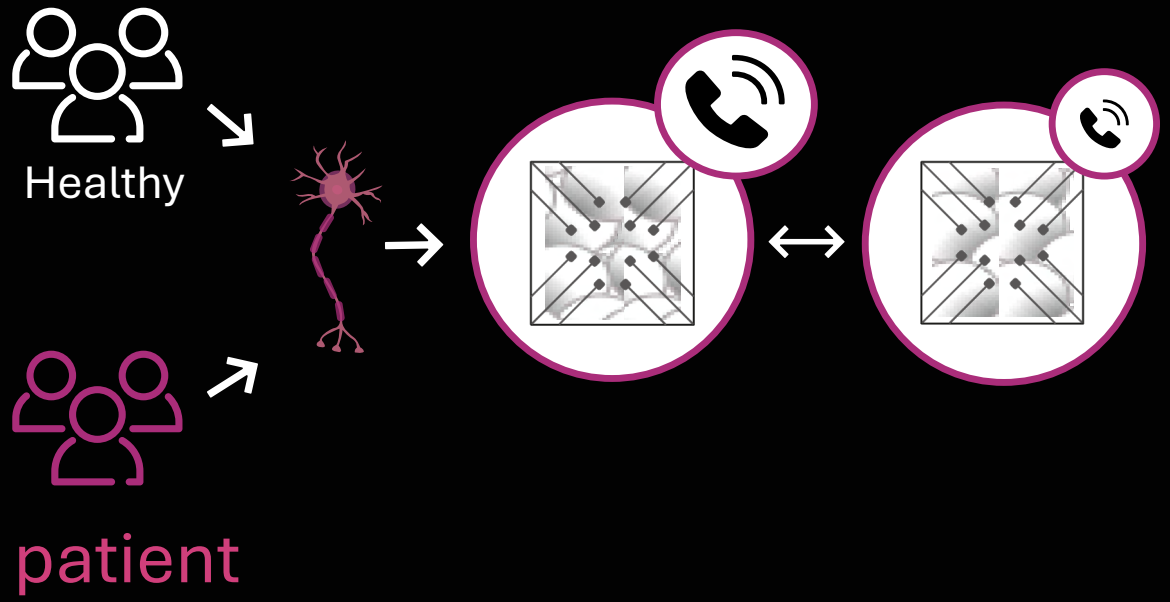


With whom?

How loud?



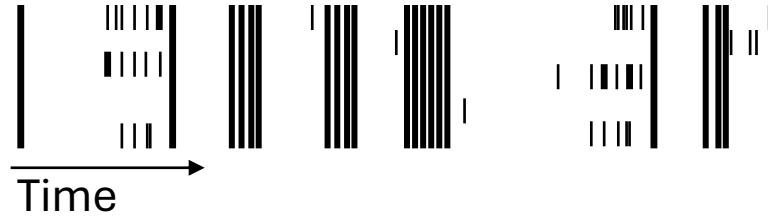
# BRAIN-on-a-CHIP
# TECHNOLOGY



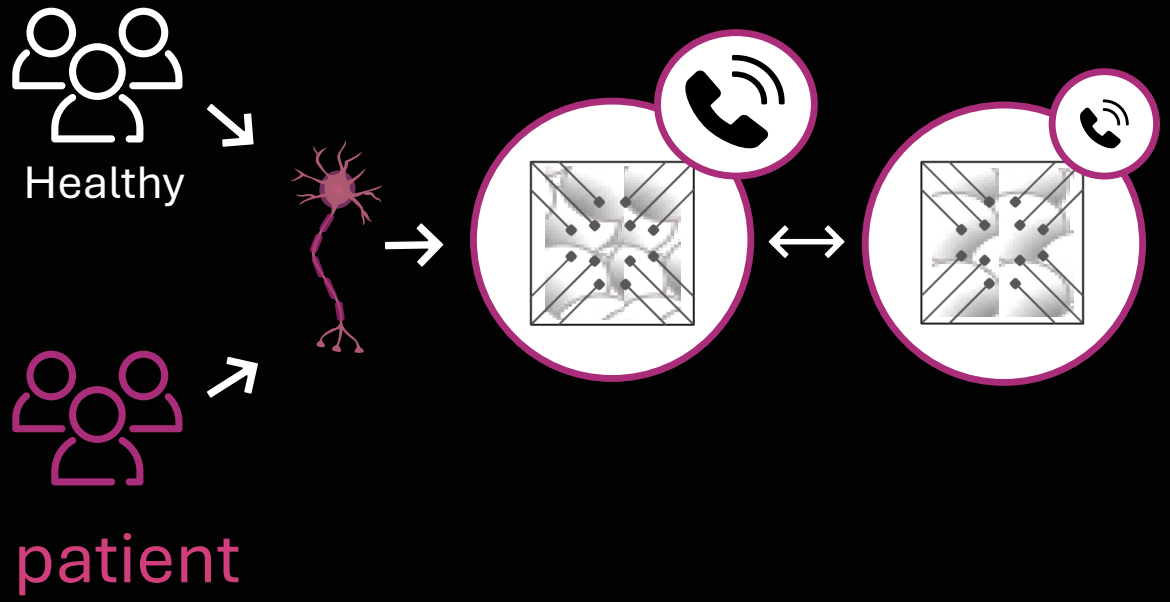

Healthy


Network fingerprint

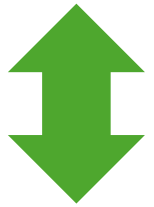
patient



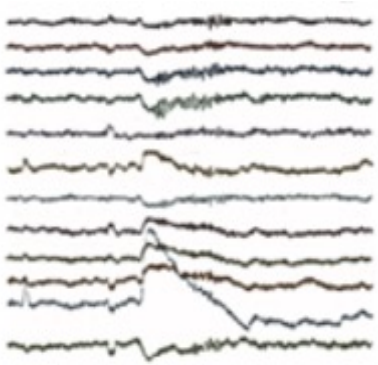
# BRAIN-on-a-CHIP
# TECHNOLOGY







EEG



# Research questions

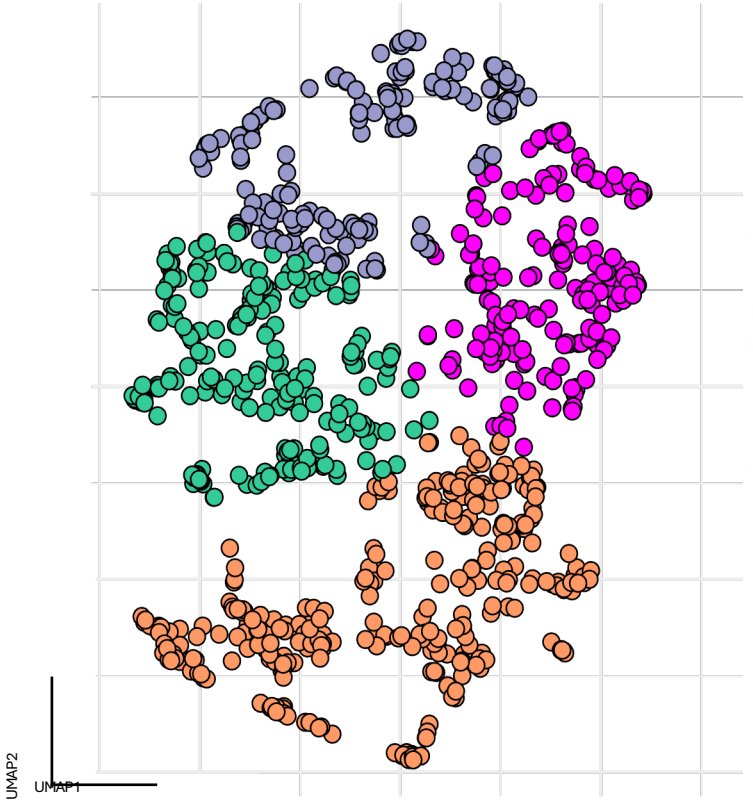
- What is  the patient/disease fingerprint?

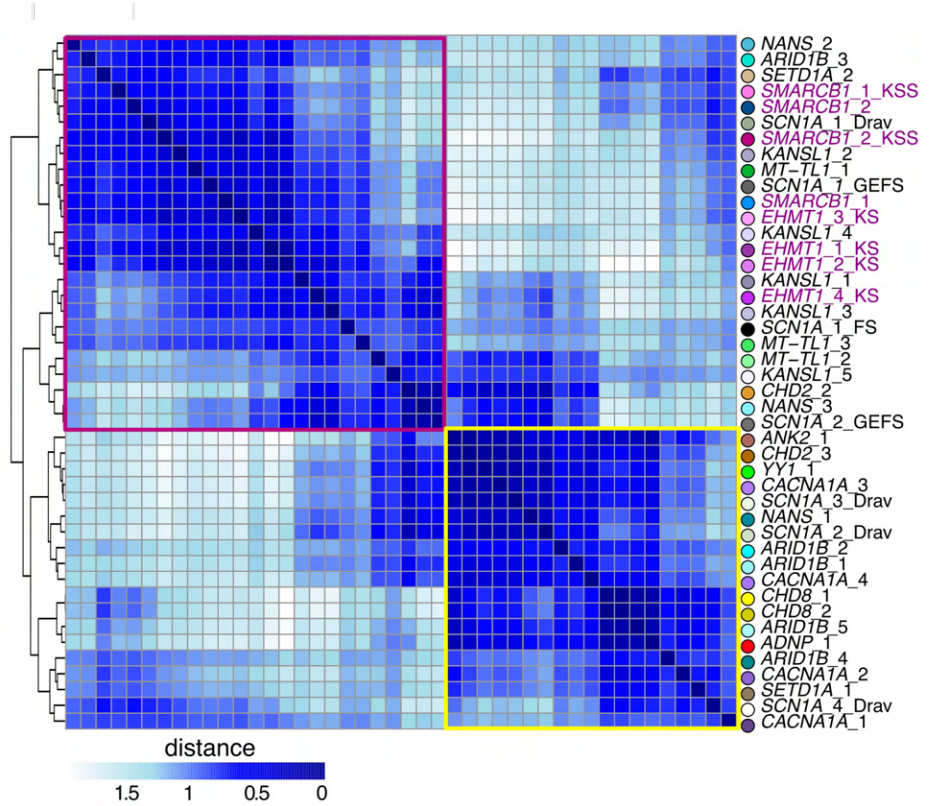


- Can we  predict the effect of medication, for example anti-seizure medication?

- Can we use brain-on-a-chip models to test genetic therapies?

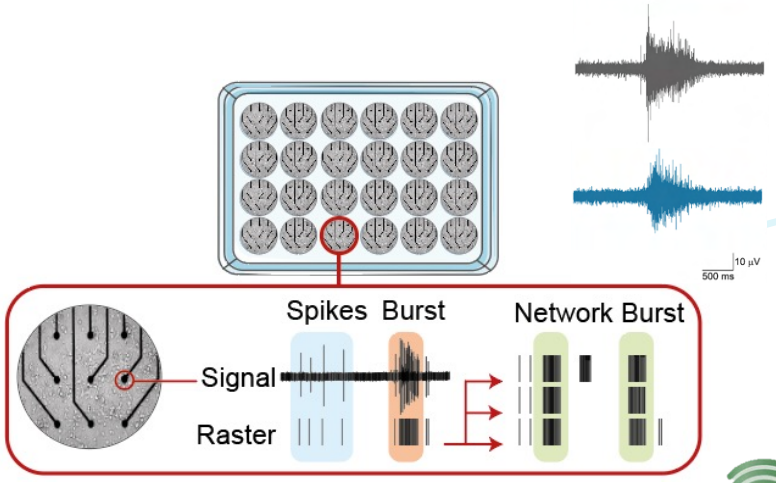
# Patient-specific network signatures during development




16 disorders  and 45 patients

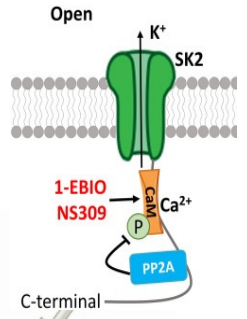
# Example: beneficial effect of combinatorial drug treatment in ataxia/epilepsy disorder

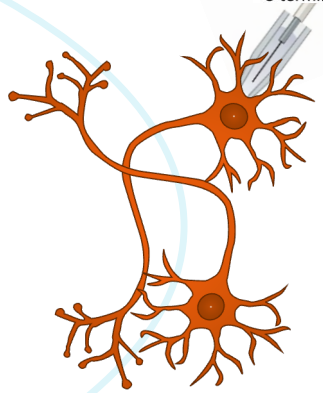



*Brain-on-a-chip activity*

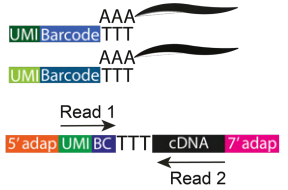
*AI & in silico* modeling

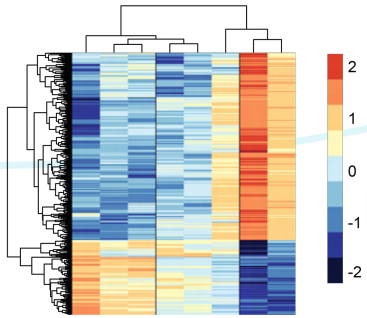
K⁺-channel



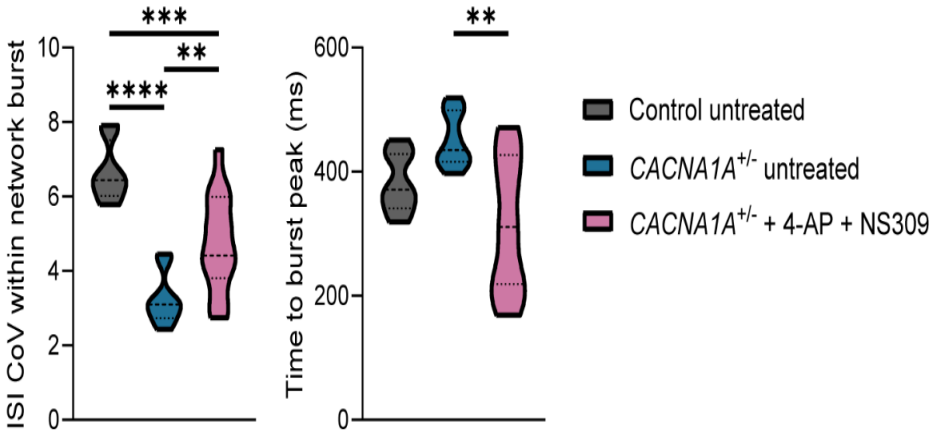



Single-cell electrophysiology



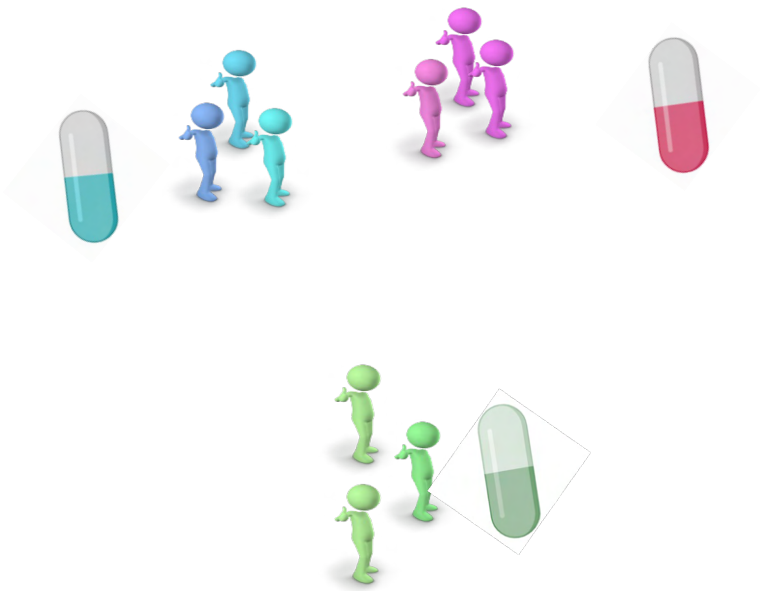

Gene expression network



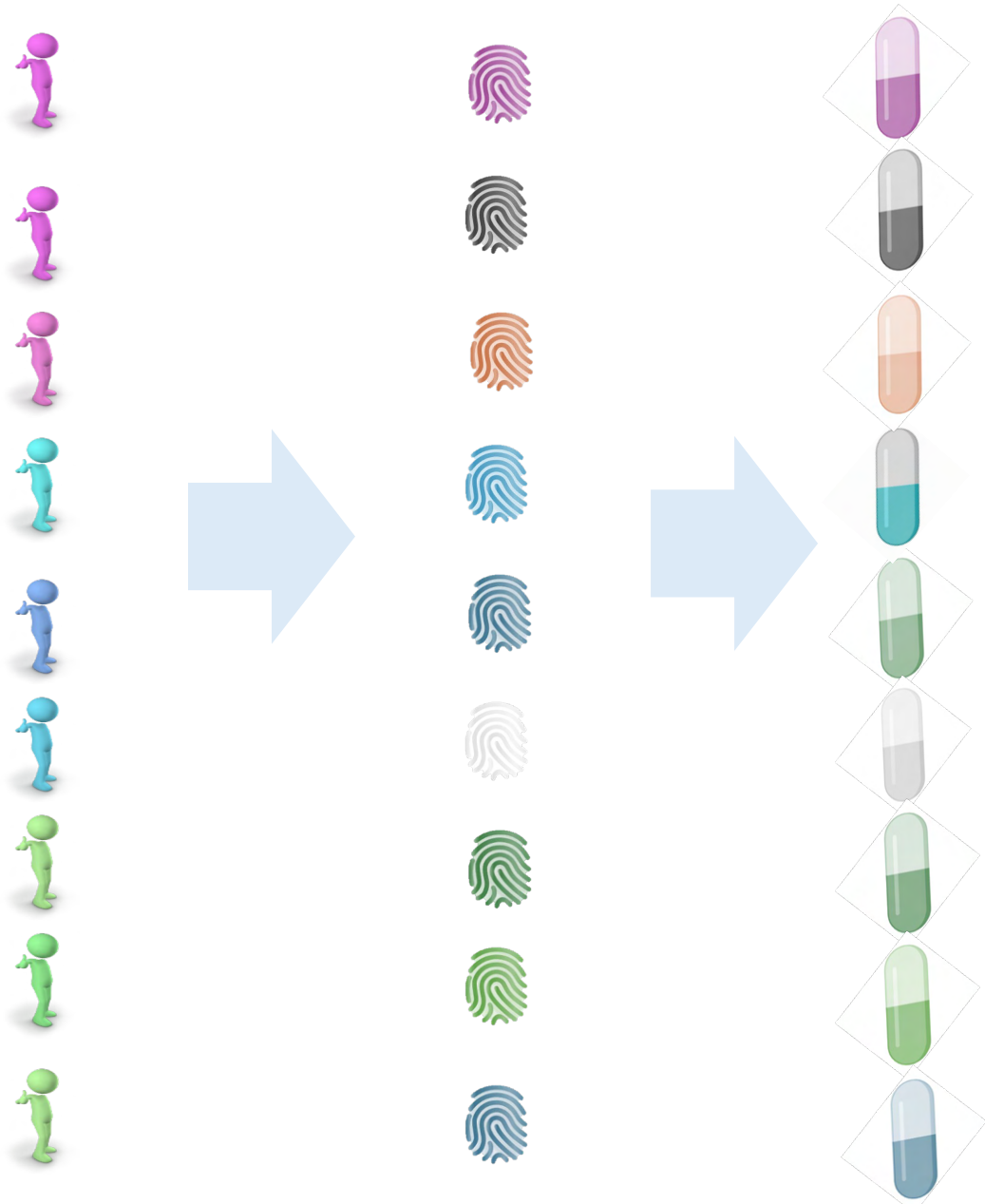

Combinatorial use op 4-AP and NS309 rescues network phenotypes

Hommersom M et al., 2025, Brain
Hommersom M et al., 2026, Stem Cell Rep

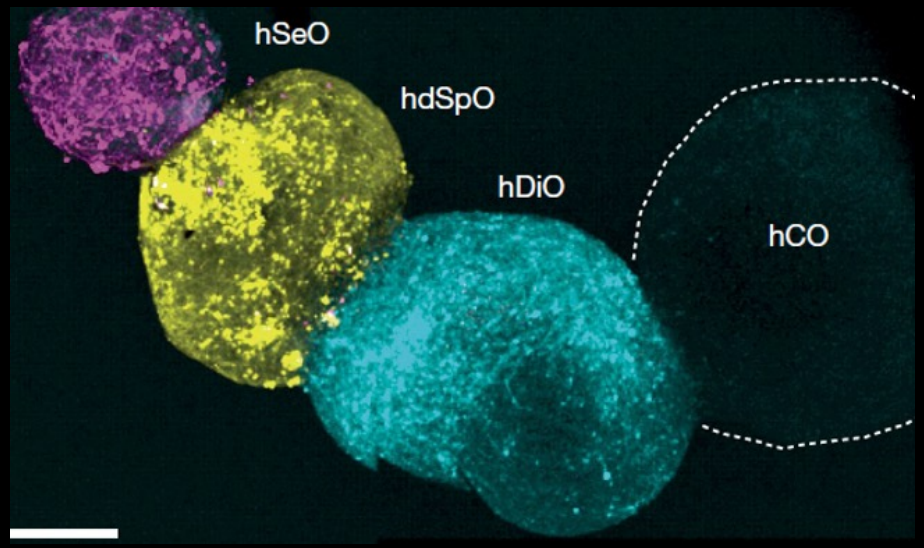
# Precision medicine for brain disorders



# Precision medicine for brain disorders

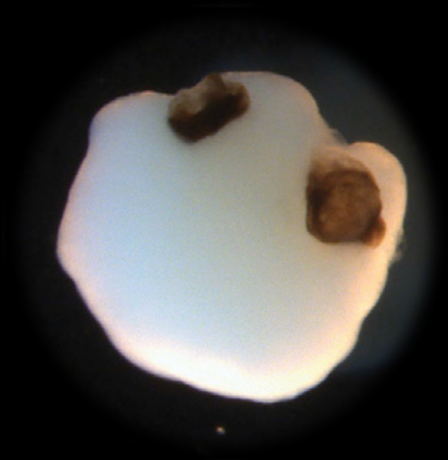


# Advanced complex brain models



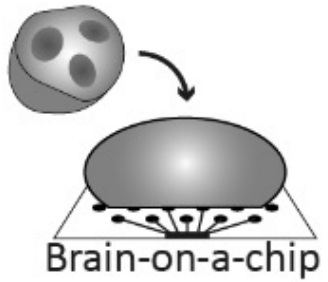

Pain circuitry

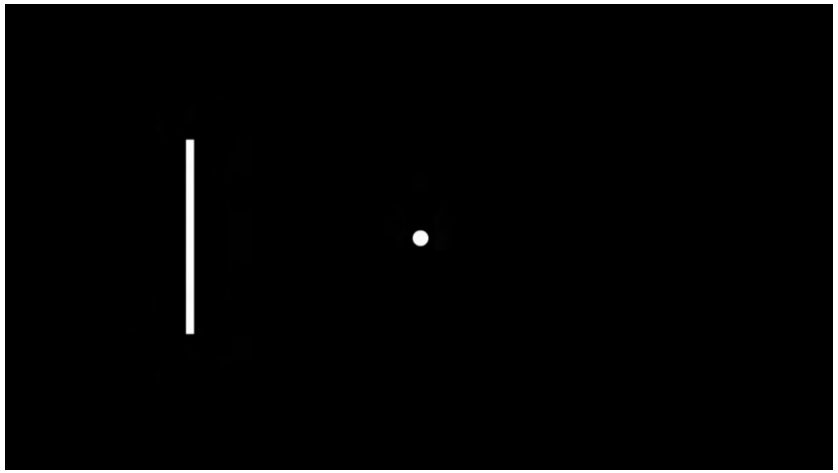
Miura Y et al, 2022



Gabriel E et al, 2021

## Organoid intelligence



Kagan B et al, 2022

# Organs-on-a-chip