

# **Stem Cells and Epilepsy:** **Modelling the Brain with Organoids**

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**Abstract**

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# **1 Introduction**

TODO: Short introduction on what epilepsy is and why it is important to study it. What is the main neuropathology behind this disease etc.

## **1.1 Traditional Models for Epilepsy Research**

TODO: Briefly mention the traditional models for epilepsy research, such as animal models and in silico models and their limitations.

## **1.2 Stem-Cell-Derived Models for the new Era**

TODO: Introducing stem-cell-derived models (e.g., hiPSCs, brain organoids, etc.) and their relevance in studying neurodevelopmental disorders like epilepsy

## **1.3 Current State of the Art**

TODO: Discussing the current state of research in this field, referencing Nieto-Estévez and Hsieh (2020) and Wang (2018) for recent advancements in modelling developmental epilepsies and neurological diseases using brain organoids.

# **2 Discussion**

TODO: Short introduction to the discussion section.

## **2.1 Stem-Cell-Derived Models for Epilepsy**

TODO: - Discussing reprogramming stem cells to model epilepsy in vitro, using Parent and Anderson (2015) and Tidball and Parent (2015) as references. - Highlighting recent findings in the field, such as Thodeson, Brulet, and Hsieh's (2017) work on neural stem cells and epilepsy and how these models have enhanced our understanding of epilepsy. - Evaluating the effectiveness and limitations of using stem-cell-derived models, possibly drawing on the comparative analysis provided by Kandemir et al. (2022) between different epilepsy models.

## **2.2 Case Studies and Practical Applications**

TODO: - Presenting specific case studies from the references, like the work by Samarasinghe et al. (2021) on identifying neural oscillations in brain organoids and their implications for understanding epilepsy. - KEY PART OF THE ESSAY: Discussing practical applications of these models in understanding and treating epilepsy, referencing Steinberg et al. (2020) and their modelling of genetic epileptic encephalopathies.

## **2.3 Other Approaches and Advancements**

TODO: - Exploring the transplantation of hiPSCs/brain organoids into living beings, referencing Hunt and Baraban (2015) for their work on interneuron transplantation and others. - Discuss the role and potential of neuroprosthetics in epilepsy treatment and research, drawing on insights from current studies or reviews.

## **2.4 Ethical Considerations**

TODO: - Discussing ethical issues surrounding stem cell research and brain organoid models, citing Farahany et al. (2018) for a comprehensive view of the ethics of experimenting with human brain tissue. - Address specific ethical questions, such as the consciousness of brain organoids and the moral implications of in vitro experimentation.

## **3 Conclusion**

TODO: - Summarising the key points, emphasising the impact of stem-cell-derived models compared to other models, especially e.g. in silico or animal testing. - Discussing future prospects of stem-cell-derived models in neuroscience, considering technological advancements and potential breakthroughs. - Addressing remaining challenges, including technical, ethical, and funding-related issues, to give a balanced view of the field's future.

## References