

**École polytechnique de Louvain**

# **Main title of the master thesis (possibly split on several lines)**

Optional subtitle

Author: **Michele CERRA**  
Supervisor: **Benoît MACQ**  
Reader: **Alexandre BERGER**  
Academic year 2022–2023  
Master [120] in Computer Science and Engineering



# Abstract

---

# Acknowledgments



# Contents

<b>Abstract</b>	<b>2</b>
<b>Acknowledgments</b>	<b>3</b>
<b>Introduction</b>	<b>7</b>
<b>1 Theoretical background</b>	<b>11</b>
<b>2 Epilepsy</b>	<b>13</b>
2.1 Overview of Epilepsy disease . . . . .	13
2.1.1 Epidemiology e Mortality . . . . .	13
2.1.2 Definitions . . . . .	14
2.1.3 Classification . . . . .	14
2.1.4 Pathophysiology . . . . .	15
2.1.5 Treatment . . . . .	15
<b>3 Methods</b>	<b>17</b>
<b>4 Results</b>	<b>19</b>
<b>5 Discussion</b>	<b>21</b>
<b>Conclusion and perspectives</b>	<b>21</b>





# Introduction

A biomarker for epileptogenesis is an objectively measurable characteristic of a biological process that reliably identifies the development, presence, severity, progression, or localization of an epileptogenic abnormality. An epileptogenic abnormality refers to the pathophysiological substrate(s) responsible for the initiation and/or maintenance



# Chapter 1

## Theoretical background



# Chapter 2

## Epilepsy disease

### 2.1 Pathophysiology and Treatment of Epilepsy

Epilepsy is a disorder of the brain characterized by a lasting predisposition to generate spontaneous epileptic seizures, and has a numerous neurobiological, cognitive, and psychosocial consequences [1]. Epilepsy affects over 50 million people worldwide, making it one of the most common neurological diseases globally. Over 75% of those with active epilepsy are untreated, mostly concentrated in low-income and middle-income countries. [2]

#### 2.1.1 Epidemiology e Mortality

Epilepsy incidence is bimodally distributed with two peaks: the first in the pediatric population less than 5 years old, and the second in people over the age of 50 years. The incidence is higher in low-income countries than high-income countries, thanks a contribution of poor hygiene, poor basic sanitation and higher risk of infection [3]. Regardless the geographical location, the prevalence of active epilepsy is usually between 4 and 12 per 1000, risk factor vary by age group [4].

The risk of death for a person with epilepsy is increased compared with the risk for the general population. Mortality can be divided into deaths directly (eg, status epilepticus, injuries, SUDEP [5]) or indirectly (eg, suicide, drowning) attributable to epilepsy [6]. SUDEP is one of the main causes of epilepsy-related death.

#### Causes

Epilepsy can have both genetic and acquired causes, with the interaction of these factors in many cases. Established acquired causes include serious brain trauma, stroke, tumours, and brain problems resulting from a previous infection.

### 2.1.2 Definitions

#### Epilepsy

The given definition of Epilepsy is usually practically applied as having two unprovoked seizures occurring more than 24h apart. But the International League Against Epilepsy (ILAE) proposed that epilepsy be considered to be a disease of the brain by any of the following conditions: [1]

- At least two unprovoked seizures occurring more than 24h apart;
- A single unprovoked seizure if recurrence risk is high (>60% over the next 10 years);
- Diagnosis of an epilepsy syndrome.

#### Seizure

An epileptic seizure is the clinical manifestation of an abnormal, excessive, purposeless and synchronized electrical discharge in the neurons, that leads to brief episodes of involuntary movement that may involve a part of the body (partial) or the entire body (generalized) and are sometimes accompanied by loss of consciousness and control of bowel or bladder function. [7]

### 2.1.3 Classification

Classification is made at three levels: seizure type, epilepsy type, and epilepsy syndromes. [8]

#### Seizure type

Seizures are first classified by onset as either focal, generalized or unknown.

- Focal Onset: Affects one part of the brain. Usually limited to a specific region in one area of the brain. Level of awareness subdivides focal seizure in those with retained awareness and impaired awareness. Retained awareness means that the person is aware of self and environment during the seizure, even if immobile. In addition, focal seizures are sub-grouped as those with motor and non-motor manifestation.
- Generalized Onset: Affects most or all of the brain. Typically congenital and occurs simultaneously in both hemispheres of the brain. They are almost always accompanied by impaired awareness. Generalized seizures are divided into motor and non-motor (absence) seizures.
- Unknown: It is the case in which the onset is missed or obscured.

**Epilepsy type**

Epilepsy are divided in: focal, generalized, combined generalized and focal, and unknown. The category combined epilepsy is used for those presenting both seizure types. Causes and comorbidities should be identified, causes are divided into six categories: genetic, structural, metabolic, infectious, immune and unknown.

**2.1.4 Pathophysiology**

Epileptogenesis is the process of converting a non-epileptic brain into one capable of generating spontaneous recurrent seizures. A seizure can be conceptualized as occurring when there is a distortion of the normal balance between excitation and inhibition within a neural network [9]. Epileptogenic networks are widely distributed for generalized epilepsies, involving thalamocortical structures bilaterally. For focal epilepsies, networks involve neuronal circuits in one hemisphere, commonly limbic or neocortical [8].

**2.1.5 Treatment**





# Chapter 3

## Methods



# Chapter 4

## Results



# Chapter 5

## Discussion



## Conclusion and perspectives





# Bibliography

- [1] R. S. Fisher, C. Acevedo, A. Arzimanoglou, A. Bogacz, J. H. Cross, C. E. Elger, J. Engel Jr, L. Forsgren, J. A. French, M. Glynn, D. C. Hesdorffer, B. Lee, G. W. Mathern, S. L. Moshé, E. Perucca, I. E. Scheffer, T. Tomson, M. Watanabe, and S. Wiebe, “Ilae official report: A practical clinical definition of epilepsy,” *Epilepsia*, vol. 55, no. 4, pp. 475–482, 2014.
- [2] S. Saxena and S. Li, “Defeating epilepsy: A global public health commitment,” *Epilepsia Open*, vol. 2, no. 2, pp. 153–155, 2017.
- [3] R. D. Thijs, R. Surges, T. J. O’Brien, and J. W. Sander, “Epilepsy in adults,” *The Lancet*, vol. 393, no. 10172, pp. 689–701, 2019.
- [4] K. M. Fiest, K. M. Sauro, S. Wiebe, S. B. Patten, C.-S. Kwon, J. Dykeman, T. Pringsheim, D. L. Lorenzetti, and N. Jetté, “Prevalence and incidence of epilepsy,” *Neurology*, vol. 88, no. 3, pp. 296–303, 2017.
- [5] Y. Langan, L. Nashef, and J. W. A. S. Sander, “Sudden unexpected death in epilepsy: a series of witnessed deaths,” *Journal of Neurology, Neurosurgery & Psychiatry*, vol. 68, no. 2, pp. 211–213, 2000.
- [6] O. Devinsky, T. Spruill, D. Thurman, and D. Friedman, “Recognizing and preventing epilepsy-related mortality,” *Neurology*, vol. 86, no. 8, pp. 779–786, 2016.
- [7] WHO, “Epilepsy fact sheet,” 2023.
- [8] R. S. Fisher, J. H. Cross, J. A. French, N. Higurashi, E. Hirsch, F. E. Jansen, L. Lagae, S. L. Moshé, J. Peltola, E. Roulet Perez, I. E. Scheffer, and S. M. Zuberi, “Operational classification of seizure types by the international league against epilepsy: Position paper of the ilae commission for classification and terminology,” *Epilepsia*, vol. 58, no. 4, pp. 522–530, 2017.
- [9] R. S. Fisher, W. v. E. Boas, W. Blume, C. Elger, P. Genton, P. Lee, and J. Engel Jr., “Epileptic seizures and epilepsy: Definitions proposed by the

international league against epilepsy (ilae) and the international bureau for epilepsy (ibe),” *Epilepsia*, vol. 46, no. 4, pp. 470–472, 2005.

UNIVERSITÉ CATHOLIQUE DE LOUVAIN

École polytechnique de Louvain

Rue Archimède, 1 bte L6.11.01, 1348 Louvain-la-Neuve, Belgique | [www.uclouvain.be/epl](http://www.uclouvain.be/epl)