

# Implementation of the State Epilepsy Registry in Chihuahua, a Border State in Northern Mexico

## Abstract

**Introduction:** The Priority Epilepsy Program (PPE) in Mexico created and analyzed the registry of patients with epilepsy in the state of Chihuahua.

**Subjects and methods:** 649 patients with epilepsy from medical consultations in the public and private sectors of the State of Chihuahua were entered into the National Epilepsy Registry. The registry was compiled from March 2021 to December 2022 using questionnaires and data from electronic records.

**Results:** Of the 649 patients, 334 (51.5%) were male and 315 (48.5%) were female. A total of 18.6% had a family history of epilepsy and 4.3% had a family history of febrile seizures. A total of 303 patients (46.7%) had focal seizures, 288 (44.4%) had generalized seizures, and 34 (11.2%) had focal seizures that progressed to bilateral tonic-clonic seizures. In 2 cases (0.3%), the onset was unknown, and 56 cases (8.6%) were unclassified. A total of 595 (91.7%) did not meet the characteristics of a syndrome. There were 31 cases (4.8%) of epilepsy in newborns. At the time of registration, 574 patients (88.4%) were taking anti-seizure medication and 75 patients (11.6%) were no longer taking it. Five patients (0.8%) underwent epilepsy surgery: one callosotomy, two vagal stimulators, one lesionectomy, and one transpial resection.

**Conclusion:** The pediatric population predominated, and the top three causes of epilepsy were brain malformations, brain atrophy, and hypoxic-ischemic encephalopathy. In adults, ischemic stroke, traumatic brain injury, and brain tumors were reported. The most commonly used anti-seizure drugs were levetiracetam and valproic acid. The frequency of refractory epilepsy was 43 cases (6.6%).

**Keywords:** antiseizure, epilepsy, etiology, registries, seizures, syndrome

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## Introduction

A registry of patients with epilepsy in public hospitals participating in the Priority Epilepsy Program (PPE) was created in Mexico. The registry captured more than 10,000 patients throughout Mexico, and this is a subanalysis of the state of Chihuahua.<sup>1-3</sup> This registry will be useful for improving epilepsy care in the public health sector, in conjunction with academic training meetings on epilepsy.

## Patients and methods

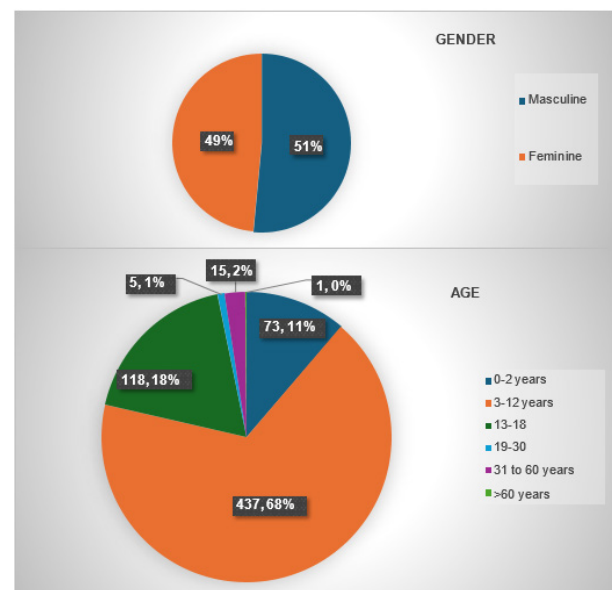
All patients with epilepsy who were scheduled and treated in the public and private health sectors with informed consent for their medical care during the COVID-19 pandemic were entered into the National Epilepsy Registry. The registry was compiled from March 2021 to December 2022. The electronic file was reviewed and direct questioning of the patient or family member was carried out in the public sector: Chihuahua Children's Specialty Hospital, Chihuahua Central Hospital, and Delicias Regional Hospital, as well as in the private offices of two neurologists and a pediatric neurologist.

The variables were: age, sex, type of seizure based on the 2017 ILAE Classification, number of cases of epilepsy in pregnancy, in newborns, epileptic syndromes, etiology, comorbidities, laboratory and office studies performed, pharmacological treatment, surgical treatment, seizure control, causes of seizure uncontrolledness, presence of status epilepticus, number of deaths, and type of specialist who treated the epilepsy and comorbidities.

This is an observational, multicenter study registered in clinical trials at the U.S. National Library of Medicine at the National Institutes of Health, ClinicalTrials.gov ID: NCT04383522.

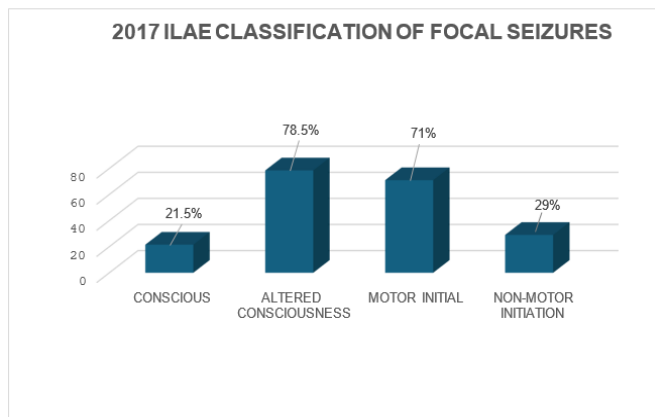
## Results

There were a total of 649 patients in the Chihuahua State Epilepsy Registry. Figure 1 shows the prevalence of epilepsy based on gender and age. The age of most of the registered patients was between 3 and 12 years (67.3%); it is known that the highest incidence of epilepsy occurs in the first 10 years of life.<sup>4</sup>



**Figure 1** Prevalence of epilepsy in Chihuahua, Mexico, based on gender and age.

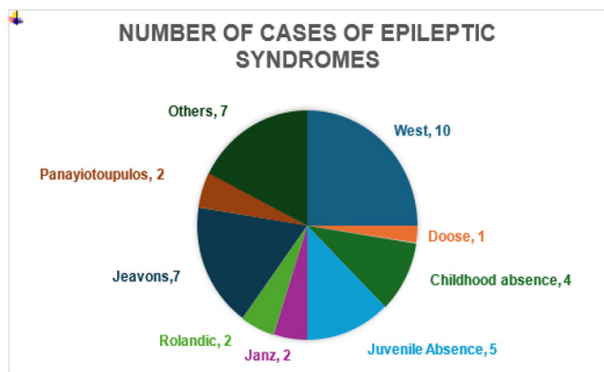
Among personal family history, 121 patients (18.6%) reported a family history of epilepsy, and 28 patients (4.3%) had relatives with febrile seizures. The most frequent type of seizure (Level I of the ILAE 2017 epilepsy classification) was focal, observed in 303 patients (46.7%), followed by generalized seizures in 288 patients (44.4%) and focal seizures progressing to bilateral tonic-clonic seizures in 34 patients (11.2%) of the total number of focal seizures. In 2 cases (0.3%), the onset was unknown, and 56 cases (8.6%) were unclassified.<sup>2,5</sup> The most common type of epilepsy (Level II of the ILAE 2017 epilepsy classification) was focal in 281 patients (43.3%), followed by generalized epilepsy in 263 patients (40.5%) and combined focal and generalized epilepsy in 19 patients (2.9%). The different types of focal seizures are described in Figure 2.



Focal seizures	clonic	93 (43.3%)
	tonic	76 (35.3%)
	atonic	18 (8.4%)
	motor initial	5 (2.3%)
	automatisms	5 (2.3%)
	epileptic spasm	2 (0.9%)
	hyperkinetic	2 (0.9%)
Focal seizures non-motor initiation	myoclonic	6 (2.8%)
	other	10 (4.7%)
	behavior arrest	36 (40.9%)
	autonomic	9 (10.2%)
	sensory	9 (10.2%)
	emotional	7 (8%)
	cognitive	3 (3.4%)
Total 215 (%)	other	24 (27.3%)

**Figure 2** Description of the types of focal seizures. ILAE 2017 classification of epilepsy.

**Epileptic syndromes** (Level III of the ILAE 2017 classification of epilepsy). A total of 595 (91.7%) did not meet the characteristics of a syndrome. Figure 3 describes the epileptic syndromes.<sup>6-8</sup>



**Figure 3** Epileptic syndromes, number of cases.

In the registered group, 315/649 patients were women, only one of whom was pregnant, and no complications were recorded in this case. In the group of newborns with epilepsy, 31 cases (4.8%) were recorded, all of which presented electroencephalographic and clinical abnormalities. There were no records of newborns with epileptogenic activity on EEG without clinical correlation. The etiology and frequency are shown in Table 1. Unknown etiology was recorded in 281 cases (43.3%), followed by structural abnormalities such as malformations, cerebral atrophy, and hypoxic-ischemic encephalopathy, as this registry covers a predominantly pediatric population. Studies published in predominantly adult populations highlighted ischemic stroke, traumatic brain injury, and brain tumors.<sup>9-12</sup>

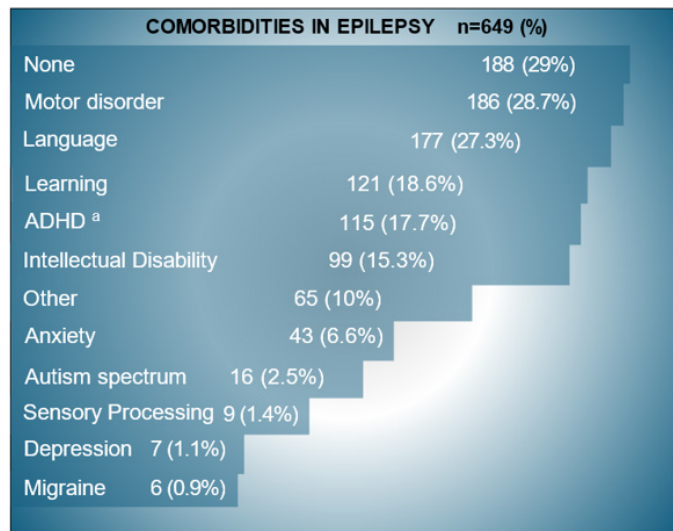
**Table 1** Frequency of epilepsy etiology according to the 2017 ILAE Classification of Epilepsy

Etiology of epilepsy n (%)	
<b>Structural, n (%)</b>	<b>272 (41.9%)</b>
Malformations	82 (30.1%)
Brain atrophy	58 (21.3%)
Hypoxic-ischemic encephalopathy	56 (20.6%)
Mesial temporal sclerosis	20 (7.4%)
Cerebrovascular accident (CVA)	18 (6.6%)
Traumatic brain injury (TBI)	15 (5.5%)
Neuroinfection	4 (1.5%)
Neurodegenerative diseases	4 (1.5%)
Other	4 (1.5%)
Tumor	3 (1.1%)
Neurocysticercosis	2 (0.7%)
<b>Genetics, n (%)</b>	<b>95 (14.6%)</b>
<b>Infectious, n (%)</b>	<b>43 (6.6%)</b>
<b>Metabolic, n (%)</b>	<b>29 (4.5%)</b>
<b>Immune, n (%)</b>	<b>14 (2.2%)</b>
<b>Unknown, n (%)</b>	<b>281 (43.3%)</b>

People with epilepsy are 2.5 times more likely to have a neurodevelopmental disorder and 4.5 times more likely to have multiple disorders. In the Chihuahua registry, 29% have no comorbidity associated with epilepsy. Language disorders were observed more frequently than those recorded in the Mexican Clinical Guidelines of the PPE; Motor Disorders are the most frequent comorbidity, followed by Language Disorders; Attention Deficit Hyperactivity Disorder (ADHD) occurs with a frequency very similar to that recorded in other reports; while Learning Disorders, Intellectual Disabilities, Autism Spectrum Disorders, and Sensory Disorders occurred less frequently. Migraine occurred in 0.9% of patients. The different types of comorbidities, the professionals involved in their care, and the level of epilepsy control are shown in Figure 4.<sup>13</sup>

Chihuahua has a large geographical area and distances of more than 10 hours to reach some towns. Medical follow-up has been strengthened through the use of telemedicine and satellite internet to establish a link in the regions of the Sierra Tarahumara. Medicines and requests for tests are sent by courier from the Health Sector, and if a certain community has the possibility of subrogation of paraclinical studies, these were reviewed synchronously in virtual consultation using health technologies. All these actions were driven by the SARS COV2 pandemic, the conversion of COVID hospitals, and home confinement. The laboratory and office studies performed are shown in Table 2. An important part of epilepsy treatment is patient tolerance to single or combination medications. The proper use of anti-seizure

drugs includes correct dosing and patient adherence. As epilepsy is a chronic condition, measuring blood levels of the drug and evaluating the possible presence of adverse side effects in other organs is an indicator of adequate monitoring of patients with epilepsy during the medical follow-up process.



<sup>a</sup>ADHD, attention deficit hyperactivity disorder

Management of comorbidity	n (%)
Psychiatry	11 (2.5%)
Other Medical Specialist	300 (67.7%)
Psychologist	87 (19.6%)
Learning Therapy	36 (8.1%)
Speech-Language Therapy	84 (18.9%)
Sensory Therapy	1 (0.2%)
Physical Therapy	111 (25%)
Behavioral Modification Therapy	11 (2.5%)
Other Therapies	3 (0.7%)
0 seizures per month	549 (84.6%)
1-3 seizures per month	74 (11.4%)
4-6 seizures per month	7 (1.1%)
7-10 seizures per month	4 (0.6%)
>10 seizures per month	15 (2.3%)

Figure 4 Treatment of comorbidities and control of epilepsy.

Table 2 Laboratory and diagnostic tests requested.

Laboratory and office studies n (%)	
<b>Laboratories</b>	<b>n (%)</b>
Blood biometry	468 (72.1%)
Liver function tests	469 (72.3%)
Blood chemistry	361 (55.6%)
Serum levels	36 (5.5%)
<b>Electroencephalogram</b>	<b>n (%)</b>
No EEG recording <sup>a</sup>	29 (4.4%)
With EEG recording	610 (94%)
Normal	121 (19.8%)
Abnormal	489 (80.2%)
<b>Neuroimaging</b>	<b>n (%)</b>

Table 2 Continued...

No neuroimaging study	226 (34.8%)
Cranial CT scan <sup>b</sup> Brain	176 (27.1%)
MRI <sup>c</sup>	255 (39.3%)
PET <sup>d</sup>	1 (0.2%)
Video EEG	1 (0.2%)
Invasive study	1 (0.2%)

<sup>a</sup>EEG, electroencephalogram; <sup>b</sup>CT, computed tomography; <sup>c</sup>brain MRI, magnetic resonance imaging; <sup>d</sup>PET, positron emission tomography

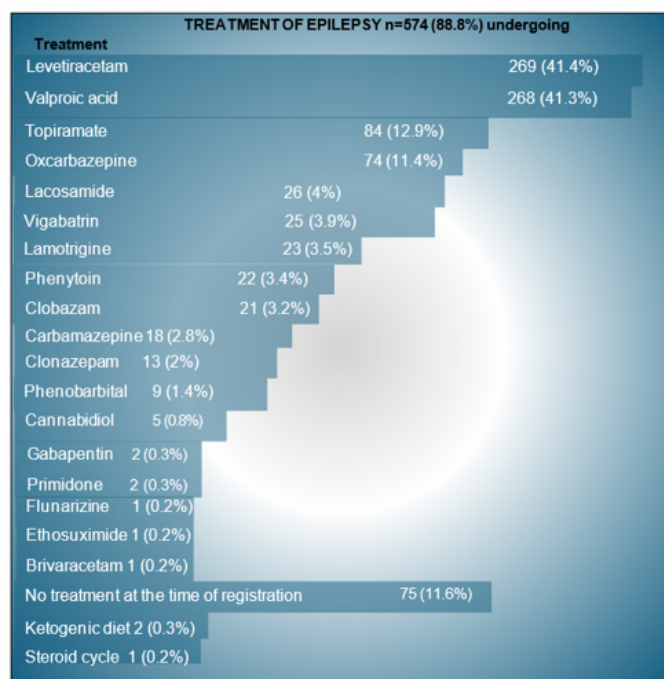
Electroencephalograms are important for the diagnosis of epilepsy, classification, and response to treatment. In the pediatric population, not all patients cooperate in order to perform an electroencephalogram (EEG), and treatment is initiated based on the clinical presentation of epileptic events.

Table 3 describes cases of refractory epilepsy, those requiring epilepsy surgery, and epilepsy triggers.

Table 3 Persistence of epileptic seizures, epilepsy surgery, status epilepticus, epilepsy triggers, and specialist who provided care

<b>Refractory epilepsy after 2 regimens of 2 anticonvulsant drugs</b>	<b>43 (6.6%)</b>
<b>Epilepsy surgery</b>	<b>5 (0.8%)</b>
Callosotomy	1 case
Vagal stimulator	2 cases
Lesionectomy	1 case
Transpial resection	1 case
<b>Status epilepticus</b>	<b>36 (5.5%)</b>
Motor type	33 (91.7%)
Non-motor	3 (8.3%)
<b>Epilepsy triggers</b>	<b>514 (79.2%)</b>
None	514 (79.2%)
Fever	59 (43.7%)
Infections	65 (48.1%)
Stress	10 (7.4%)
Sleeplessness	5 (3.7%)
Alcohol	1 (0.3%)
Menstrual period	2 (0.6%)
Lack of medication	32 (23.7%)
Other	22 (3.4%)
<b>Institutional medical care</b>	<b>634 (97.7%)</b>
Adult neurologist	13 (2%)
Child neurologist	634 (97.7%)
Family physician	2 (0.3%)

Anti-seizure drug therapy allows patients to remain seizure-free in up to 70% of cases. In Chihuahua, 84.6% of patients were reported to be seizure-free. Figure 5 describes the different anti-seizure drugs used. Levetiracetam was the most frequently used (considered a new anti-seizure drug), and the second most frequently used was valproic acid (a conventional drug).<sup>14-17</sup>



**Figure 5** Drugs used to treat epilepsy.

## Discussion

The percentage of serum levels measured for anti-seizure drugs such as levetiracetam and topiramate, two of the most commonly used drugs, was low due to the high cost of measurement or because sometimes the necessary laboratory reagents are not available for measurement in public hospitals. Neuroimaging studies were not performed in 34.8% of patients, which we believe was due to the conversion of specialty hospitals into COVID hospitals, limiting the performance of imaging studies such as cranial CT scans, and the high cost of brain MRI.

The pediatric population predominated in this registry, and the three leading causes of epilepsy were brain malformations, brain atrophy, and hypoxic-ischemic encephalopathy, in order of frequency. The frequency of patients in remission from epilepsy was high at 84.6%, and the frequency of persistent epileptic seizures after trying two regimens of two anti-seizure drugs was 43 cases (6.6%), a percentage below that reported in other studies, which refractory epilepsy is reported at 30%. Patients with Lennox-Gastaut syndrome remained confined to their homes and were not included in this registry because they were unable to attend consultations, as patients with difficult-to-control epilepsy were recommended to stay at home. They were only seen via video call, allowing an adult to go to the hospital to pick up their prescriptions, and were therefore missing from this registry. Motor disorders were the most frequent comorbidity, and when compared with the percentages of comorbidities reported in the Clinical Guidelines of the Priority Epilepsy Program in Mexico, language disorders were observed more frequently in Chihuahua.

## Conclusion

In the state of Chihuahua, the coverage of epilepsy care and control in the population is favorable due to the high percentage of seizure-free patients. The percentage of electroencephalogram studies performed was 94%, which is optimal, but there are deficiencies in the coverage of neuroimaging studies that provide information on

the etiology of epilepsy and, therefore, the prognosis. Serum levels of anticonvulsant drugs were found to be low, which is relevant for dosages in appropriate ranges for better control of epilepsy and to avoid prolonging treatment times.

## Authors' contribution

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## Conflicts of interest

The authors declare that there are no conflicts of interest.

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## Limitations

Its cross-sectional nature prevents us from having information on patients over time, pandemic times, and confinement measures for the epilepsy population, which is difficult to control.

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