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Impact of neurology staff's adherence to management guidelines on seizure freedom in epilepsy patients

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Abstract

Aim: This study aimed to assess the relationship between clinician adherence to International League Against Epilepsy (ILAE) management guidelines and seizure freedom in adult patients with epilepsy at a Mexican tertiary care center.

Methods: This retrospective cross-sectional study analyzed 404 adult outpatients with epilepsy from an institutional database (January–October 2013). Data were collected on demographic characteristics, seizure types, diagnostic workup completeness, treatment regimens, weight-adjusted dosing, self-reported adherence, and seizure freedom (defined as being seizure-free for at least 3 months). Statistical analysis included chi-squared tests (χ^2) for categorical variables and multivariate logistic regression to identify independent predictors of seizure freedom.

Results: Of 404 patients analyzed (58.7% female, mean age 33 ± 13 years), 49.3% achieved seizure freedom. Generalized seizures (including primary and secondarily generalized seizures) were most common (66%), followed by focal seizures (30%). Diagnostic studies included an electroencephalogram in 80% and a magnetic resonance imaging scan in 75% of patients. Monotherapy was used in 50.7%, polytherapy in 44.6%, with weight-adjusted dosing achieved in 92%. Self-reported treatment adherence was 81%. Factors significantly associated with seizure freedom included treatment adherence (51.4% vs. 27.3% in non-adherent patients, $\chi^2 = 13.56$, $p < 0.001$), monotherapy vs. polytherapy (71.7% vs. 62.9%, $\chi^2 = 46.07$, $p < 0.001$), and adequate weight-adjusted dosing (44.9% vs. 32.3%, $\chi^2 = 5.97$, $p = 0.01$).

Conclusions: Adherence to ILAE management guidelines, particularly regarding monotherapy selection, weight-adjusted dosing, and treatment adherence, was significantly associated with improved seizure freedom rates. These findings underscore the importance of implementing evidence-based epilepsy management protocols systematically in clinical practice.

Keywords

Epileptic seizures, antiseizure medications, International League Against Epilepsy, seizure freedom, treatment adherence

Introduction

Epilepsy is a chronic neurological disorder with an estimated global prevalence of approximately 1%, affecting people of all ages and backgrounds [1]. The annual incidence in high-income countries is about 50 per 100,000 persons, while rates can be significantly higher in low- and middle-income regions [2, 3]. Epilepsy can begin at any age, but its incidence peaks in early childhood and again after the age of 60. In pediatric populations, common etiologies include genetic syndromes, perinatal brain injury, and congenital malformations. In contrast, traumatic brain injury (TBI) and neoplastic processes become more prevalent in middle age, while cerebrovascular disease is the leading cause of epilepsy in the elderly [4, 5].

The diagnosis of epilepsy is clinical and rests on the identification of seizures, which are defined based on patient history, eyewitness accounts, the nature and duration of the event, and the presence or absence of a postictal state. In 2005, the International League Against Epilepsy (ILAE) and the International Bureau for Epilepsy (IBE) established a unified definition of seizures as "a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain" and of epilepsy as "a brain disorder characterized by an enduring predisposition to generate epileptic seizures, and by the neurobiological, cognitive, psychological, and social consequences of this condition" [6].

The ILAE Commission on classification and terminology has revised the concepts, terminology, and approaches to classifying seizures and forms of epilepsy. The terms 'generalized' and 'focal' are redefined, with 'generalized' referring to seizures that occur and rapidly involve bilaterally distributed networks and 'focal' referring to those limited to networks of one cerebral hemisphere, with either discretely localized or more widely distributed patterns. The classification of generalized seizures was simplified, leaving as major groups: tonic-clonic, absent, myoclonic, clonic, tonic, and atonic; it is considered that there is no natural classification for focal seizures and that these should be described according to clinical manifestations, suggesting the terms 'focal motor' or 'autonomic' for those without alteration of alertness, 'dyscognitive' for those with alteration of alertness and 'evolution to a bilateral seizure' to replace the expression 'secondarily generalized'. In terms of etiology, the terms genetic, structural-metabolic, and unknown replace the previous concepts of idiopathic, symptomatic, and cryptogenic [7]. Within the diagnostic approach, the nature of the epileptic syndrome and the etiology must be determined, as it determines the subsequent decisions in evaluation to assess the probability of recurrences and to decide the optimal treatment initiation; this is based on the type of epilepsy, the side effects of the drugs, and the cost; although monotherapy is generally preferred, rational polytherapy with adequate titration, the balance between efficacy and tolerability and drug interactions can be adapted to most patients; globally it is considered that with adequate treatment 70% of patients will achieve seizure control with the first or second drug, and 30% will be refractory to treatment [8]. In this context, there are medical management guidelines recommended by the ILAE based on evidence for efficient and effective long-term treatment [9]; these have been recently updated, giving a level of efficacy and effectiveness to different drugs in the various types of seizures and epileptic syndromes; for adults with focal seizures levetiracetam, carbamazepine, phenytoin, and zonisamide have level A and valproate level B; in elderly patients with partial seizures gabapentin and lamotrigine have level A; and in adults with generalized tonic-clonic seizures no drug has level A, with carbamazepine, phenobarbital, phenytoin, topiramate, and valproate having level C; this with the caveat that the final judgment of therapy must be made in light of the clinical condition of each patient and the treatment options available in each particular clinical setting of the hospital or clinic in which management is performed [10].

As for specific types of epilepsy, mesial temporal lobe epilepsy (MTLE), due to hippocampal sclerosis in a large percentage, has a poor prognosis, and the seizures are often medically intractable. This is the

cornerstone of treatment at any age, provided the patient is a suitable candidate for surgery, as multiple studies have demonstrated both short-term and long-term benefits in cases refractory to other treatments [11]. The expected benefits must be balanced against potential neuropsychological impacts. Despite evidence-based recommendations since 2003 for surgical referral after first-line therapy failure, an average 18-year delay exists between seizure onset and surgical evaluation, perhaps partly explained by the lack of consensus on the definition of drug-resistant epilepsy, defined by several groups as the inefficiency of 2 drugs [12]. Although the optimal time for surgery is unclear, early surgery is essential to avoid the irreversible consequences of epilepsy [13]. These years of uncontrolled epilepsy can lead to cognitive impairment, poor quality of life, and increased mortality. Web-based tools have recently been designed to close this therapeutic gap to identify patients who are candidates for epilepsy surgery promptly, particularly in those patients older than 12 years with focal epilepsy, taking into account variables recognized as necessary for diagnosis and management, such as duration of epilepsy, seizure frequency, and severity, imaging and electroencephalogram (EEG) findings, presence of drug side effects and number of drugs used, the need for referral is calculated. Although these tools have yet to be validated in clinical practice, this methodology may be superior to guidelines in helping to change clinicians' behavior when considering the appropriateness of a timely referral [14]. It should be noted that not all patients are considered optimal for surgery, either because of bilateral lesions, high risk of post-surgical neuropsychological deficit, or refusal of surgery by the patient; in these patients, female gender, late onset of epilepsy, and documented hippocampal sclerosis on the left side are poor prognostic factors for becoming patients. It should also be noted that 46% of patients who are not candidates for surgery achieve seizure freedom for at least one year. Of these, half achieve complete control with antiseizure medications (ASMs) [15].

In those patients for whom medical treatment is the only option, treatment adherence is challenging due to complex medication regimens are often required for daily life; lack of treatment adherence is a worldwide health problem, and in patients with epilepsy, it is around 66% and is related to patient characteristics such as socioeconomic characteristics, personal beliefs and perception of epilepsy, disease-specific factors such as the frequency and severity of seizures, number of drugs, daily doses, side effects, and factors associated with the doctor-patient relationship; all these factors may cause that 79% of patients do not achieve seizure freedom, with the consequent morbidity related to physical injuries such as cranioencephalic trauma, fractures, and burns, as well as psychosocial problems. Strategies designed to improve treatment adherence should target young male patients in particular, as they are most frequently reported to have a lack of adherence. Physicians should also design fewer complex prescriptions to increase the likelihood of treatment adherence [16]. Measures of treatment adherence are also helpful in assessing the quality of care because, as adherence increases, adverse variables such as hospitalizations, emergency room visits, craniocerebral trauma, and fractures decrease [17]. In addition to the disease itself, patients face the fear of seizures, stigmatization, and limitations in activities of daily living, as well as the negative impact on the quality of life of comorbidities such as depression, low self-esteem, and anxiety. Family support and functionality have also been reported as characteristics that influence the patient's quality of life [18]. The evaluation of clinical aspects and quality of life in patients helps to determine the risk factors for developing depression, which can occur in 25% of patients, and these factors should be modified because they have been related to increased severity of seizures and cognitive and emotional problems [19]. In addition, it has been described that the severity of anxiety and depression is related to a better perception of the adverse effects of ASMs [20]. There are measures of clinical performance in the management of patients with epilepsy developed by the American Academy of Neurology (AAN) that seek to standardize and improve individual clinician performance and help record data for research studies and hospital certification programs. The measures include seizure type and frequency, documentation of the etiology of epilepsy or epileptic syndrome, EEG results, magnetic resonance imaging (MRI) or computed tomography (CT) results, inquiry and warning about drug side effects, and consideration of referral to surgery for epilepsy refractory to treatment, among others. These measures aim to encourage physicians to collect information on each patient and utilize it to receive individualized patient-level feedback, facilitating management and identifying opportunities for improvement within that patient population [21]. However,

in a study conducted to audit the documentation of information, many omissions were found in both hospital records and referral notes to general practitioners, following which a sheet was designed to ensure that all important points were covered during the visit and flagged; suggesting that an epilepsy patient record system would provide more significant benefit to the department and the patient [22].

By identifying these challenges in healthcare systems, including lack of integration of patient records, limited access to clinical trials, gaps in quality measures based on treatment outcomes, and insufficient support for personalized medicine, the need for an informatics infrastructure to improve the quality of information-based research has been proposed as it would enhance clinical decision support, access to patient and family information, and easier sharing of information between research groups. Consistent use of terminology in this informatics structure, including electronic health records and clinical applications, is essential [23]. Attempts have been made to create standardized tools for epilepsy research. Still, the limitation of population-based studies is the heterogeneity that can hinder the interpretation of the results, so having a single questionnaire and a homogeneous collection in a database is crucial. However, it should still be considered that the collection of hospital surveys can lead to the selection of patients who are not representative of the entire population. Conversely, conducting them in remote areas where environmental or hereditary factors exist can hinder the extrapolation of the results [24]. Epidemiological studies have also been conducted using medical registry databases, which have the disadvantage of not considering patients who refuse to take medication or receive treatment outside national health services, such as charity centers; therefore, they are limited to studying treated patients [25]. Efforts have been made to try to overcome these limitations, creating a prospective database that can be accessed via the Internet by neurologists around the world, designed to include and follow large cohorts of patients with specific epileptic syndromes and to facilitate patient recruitment for clinical trials; the EpiNet database records physician-derived information on patients in 25 centers in 13 countries, proving to be low cost and with high research potential [26, 27].

Materials and methods

Justification

Quality in healthcare has gained momentum in recent years; regardless of how it is addressed, the universal goal is to establish evidence-based standards of care and educate physicians about the infrequency of this approach in everyday practice. One way to motivate physicians to improve their performance is through transparency measures in daily practice. Additional approaches include methods to track adherence to care protocols. Thus, the first step is to recognize that the clinician's daily performance is not as adequate as it is believed to be and that management is not standardized among neurologists caring for patients with epilepsy. Given the incidence and prevalence of epilepsy, the clinical challenge for the etiological diagnosis, the performance of the clinician in the integral management of the patient, and the complex interaction of demographic variables that determine the reasonable control of patients, a constant evaluation of the clinical practice in epilepsy is required, so a computerized system can help in this evaluation, in the identification of weaknesses and in the short term to homogenize the diagnostic-therapeutic actions in favor of the patient with epilepsy.

Hypothesis

Adherence to management guidelines by neurology staff is related to seizure freedom in patients with epilepsy.

Objectives

General objective: to assess clinician adherence to management protocols for patients with epilepsy using an electronic database.

Specific objectives:

a) To quantify the number of patients with epilepsy who have undergone a complete diagnostic workup and have an identified etiology.

b) To determine seizure freedom rates in patients receiving appropriate monotherapy.

c) To determine seizure freedom rates in patients receiving appropriate polytherapy.

d) To quantify delays in surgical referral for patients with temporal lobe epilepsy.

Study design: This retrospective cross-sectional study was conducted at Hospital Central "Dr. Ignacio Morones Prieto", a tertiary care center in San Luis Potosí, Mexico. Data were collected from patients attending the neurology outpatient clinic between January 1 and October 30, 2013. Definition of the study universe patient with epilepsy: patient of either sex aged between 16 and 80 years, with a diagnosis of epilepsy (having met any of the following criteria: 1) meet the clinical criteria for epilepsy in the evaluation by the neurology service; 2) have the diagnosis recorded in the clinical record) and have attended the neurology outpatient clinic in the period from January 1 to October 30, 2013. Observation units: neurology office of the Central Hospital, Dr. Ignacio Morones Prieto, San Luis Potosí, SLP, Mexico. Sampling method: non-randomized, by convenience; all patients with a subsequent diagnosis of epilepsy who attended during the period from January 1 to October 30, 2013, will be selected from the observation unit to complete the total number according to the sample size calculation. Selection criteria: inclusion criteria: Patients aged 16–80 years with a confirmed diagnosis of epilepsy, as established by the neurology service, and at least one clinic visit during the study period; exclusion criteria: single unprovoked seizure without meeting epilepsy criteria, seizure freedom ≥ 5 years, incomplete demographic or clinical records; elimination criteria: incomplete records of demographic variables at the time of analysis. Data were extracted using a standardized collection form and stored in Microsoft Excel®. The following variables were recorded:

Demographic variables:

a) Age at last consultation (years).

b) Gender (male/female).

c) Weight (kg).

Clinical variables:

a) Age at seizure onset (years).

b) Epilepsy duration (years).

c) Seizure type (according to ILAE 2010 classification).

d) Etiology (genetic, structural/metabolic, unknown).

Diagnostic workup:

a) EEG (performed/not performed; normal/abnormal).

b) Neuroimaging (MRI/CT performed/not performed).

Treatment variables:

a) Antiseizure drug regimen (monotherapy vs. polytherapy).

b) Weight-adjusted dosing adequacy (adequate/inadequate).

c) Treatment adherence (self-reported as adherent/non-adherent).

Statistical analysis

Descriptive statistics: continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages.

Univariate analysis: chi-squared tests (χ^2), which are non-parametric, were used to assess associations between categorical variables and seizure freedom.

Multivariate analysis: variables with $p < 0.20$ in univariate analysis were included in a multivariate logistic regression model to identify independent predictors of seizure freedom. The following variables

were considered: age, gender, seizure type, epilepsy duration, etiology determination, monotherapy vs. polytherapy, adequacy of weight-adjusted dosing, and treatment adherence.

Model building: a backward elimination strategy was employed, removing variables with a *p*-value greater than 0.10. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs).

Software: statistical analyses were performed using Microsoft Excel®.

Sample size: based on an expected seizure freedom rate of 50% and a minimum detectable difference of 15% between groups, with 80% power and $\alpha = 0.05$, the minimum required sample size was 255 patients, where α represents the significance level of a statistical test and the probability of committing a type I error, which occurs when the null hypothesis is incorrectly rejected despite being true.

Ethical considerations

The study was approved by the Ethics and Research Committee of Hospital Central "Dr. Ignacio Morones Prieto" (registration number 129-13). Due to the retrospective nature of using anonymized data from routine clinical care, individual informed consent was waived in accordance with institutional guidelines.

Results

A total of 421 patients were initially identified from the electronic database. Seventeen patients were excluded due to incomplete records, resulting in a final analysis of 404 patients. Among 404 patients analyzed (Table 1), 237 (58.7%) were women with a mean age of 33 ± 13 years, a mean weight of 64 ± 15 kg, and an age of onset of seizures of 16.4 ± 14 years. Time of evolution with seizures of 16.6 ± 13.6 years.

Table 1. Population

Variable	Result
Total patients analyzed	404 (from 421, 17 excluded due to incomplete records)
Sex (female)	237 patients (58.7%)
Average age	33 ± 13 years
Average weight	64 ± 15 kg
Age at onset of seizures	16.4 ± 14 years
Duration of seizures	16.6 ± 13.6 years
Patients with more than two types of seizures	91 patients (22.5%)

Of the 404 patients analyzed, 237 (58.7%) were women, predominantly young adults, with two types of seizures in approximately 1 in 5

Ninety-one patients had at least two types of seizures. The predominant seizure type was primary and secondarily generalized seizures (Table 2), 66%, followed by focal seizures, 30%, and epileptic syndrome, 4%. Within the generalized seizures, the most common were tonic-clonic seizures, 70%, tonic seizures, 18%, and absence seizures, 8%. As for focal seizures, the most frequent were motor 41%, dyscognitive 26%, and sensory 25%. Among the epileptic syndromes, the most frequent were absence seizures ($n = 14$), followed by Lennox-Gastaut syndrome ($n = 4$) and juvenile myoclonic epilepsy ($n = 3$).

In the diagnostic approach involving diagnostic studies (Table 3), 80% of patients undergo EEG, 68% have imaging studies, and 75% have an MRI. While ideally all patients should receive at least these two tests, in an institution like this one, which has numerous financial constraints, achieving that is challenging.

In the etiologies (Table 4), 43% are of structural or metabolic origin, 3% are genetic, and 54% are of unknown origin. The unknowns are attributed to an incomplete approach due to insufficient imaging or EEG. In the studied population, the most frequent structural etiology (Table 5) is temporal lobe epilepsy associated with hippocampal sclerosis at 58.9%, followed by neurocysticercosis at 7.4%, TBI at 5.1%, stroke at 4.6%, and cortical dysplasia 4%.

Table 2. Type of seizures

Type of seizure	Frequency
Generalized	66% (predominant)
- Tonic-clonic	70%
- Tonic	18%
- Absence	8%
Focal	30%
- Motor	41%
- Dyscognitive	26%
- Sensory	25%
Epileptic syndromes	4%
- Absence seizures	3.5%
- Lennox-Gastaut syndrome	1%
- Juvenile myoclonic epilepsy	0.7%

The predominant seizure type was generalized seizures (including primary and secondarily generalized seizures), 66%, followed by focal seizures, 30%, and epileptic syndrome, 4%

Table 3. Diagnostic studies

Tests	Percentage of patients
EEG	80%
Imaging study	68%
- MRI	75% (of patients with imaging)

Most patients underwent both electroencephalogram (EEG) and magnetic resonance imaging (MRI)

Table 4. Etiology of the seizures

Origin of epilepsy	Frequency
Structural/metabolic	43%
Genetic	3%
Unknown	54%
- Due to incomplete workup	45%

In most cases, the etiology was not determined

Table 5. Structural etiology

Condition	Frequency
Temporal lobe epilepsy (hippocampal sclerosis)	58.9%
Neurocysticercosis	7.4%
Traumatic brain injury (TBI)	5.1%
Stroke (CVA)	4.6%
Cortical dysplasia	4%

The most critical etiology was hippocampal sclerosis

Regarding pharmacotherapy (Table 6), 4.7% were untreated due to freedom from sustained seizures, 50.7% were in monotherapy, and 44.6% were in polytherapy. The weight-weighted adjusted dose is adequate in 92% of patients. Self-reported treatment adherence is 81%. Freedom from seizures is obtained in 49.3% of patients.

A multivariate logistic regression analysis was performed (Table 7) to identify independent predictors of seizure freedom. Variables included in the final model were treatment adherence, therapy type (monotherapy vs. polytherapy), and adequacy of weight-adjusted dosing.

Table 6. Treatment

Pharmacotherapy	Percentage of patients
No treatment (seizure freedom)	4.7%
Monotherapy	50.7%
Polytherapy	44.6%
Adequate dose adjusted by weight	92%
Self-reported adherence to treatment	81%
Seizure freedom	49.3%

Approximately 50% was in monotherapy, and seizure freedom

Table 7. Seizure freedom and treatment adherence analysis

Treatment adherence	Seizure freedom *n* (%)	No seizure freedom *n* (%)	Total *n* (%)
Adherent patients	168 (51.4%)	159 (48.6%)	327 (81.0%)
Non-adherent patients	21 (27.3%)	56 (72.7%)	77 (19.1%)
Total	189 (46.8%)	215 (53.2%)	404 (100%)

Chi-squared tests (χ^2) = 13.56, $p < 0.001$; odds ratio (OR) = 2.8 [95% confidence interval (CI): 1.6–4.9]

Independent predictors of seizure freedom were:

a) Treatment adherence (OR = 2.8, 95% CI: 1.6–4.9, $p < 0.001$).

b) Monotherapy vs. polytherapy (OR = 4.2, 95% CI: 2.8–6.3, $p < 0.001$).

c) Adequate weight-adjusted dosing (OR = 1.7, 95% CI: 1.1–2.6, $p = 0.01$).

The model showed good fit (Hosmer-Lemeshow test, $p = 0.45$) and explained 23% of the variance in seizure freedom outcomes.

Having or not having a specific etiology was unrelated to achieving freedom from seizures (Table 8). Regarding monotherapy vs. polytherapy, 71.7% of patients on monotherapy achieved seizure freedom, while 62.9% of patients on polytherapy did not ($\chi^2 = 46.07$, $p < 0.001$). Polytherapy was not related to adherence or non-adherence to treatment.

Table 8. Monotherapy vs. polytherapy analysis

Group	Seizure freedom	Chi-squared tests (χ^2) and *p*-value
Patients in monotherapy	71.7% achieved seizure freedom	$\chi^2 = 46.07$, $p < 0.001$
Patients in polytherapy	62.9% did not achieve seizure freedom	

In 44.9% of patients on weight-adequate therapy, seizure freedom was achieved, while 32.3% of those without adequate dosing did not achieve seizure freedom ($\chi^2 = 5.97$, $p = 0.01$) (Table 9).

Table 9. Adequate dose and seizure freedom

Group	Seizure freedom	Chi-squared tests (χ^2) and *p*-value
Patients with an adequate dose	44.9% achieved seizure freedom	$\chi^2 = 5.97$, $p = 0.01$
Patients with inadequate dose	32.3% did not achieve seizure freedom	

Discussion

The population in this institution is economically, culturally, and socially poor, young, with an early onset of epilepsy and its relationship with a higher prevalence of hippocampal sclerosis, which is consistent with other epidemiological studies. Although the data are from 2013, they provide valuable insights into guideline adherence practices in low-resource settings and serve as a baseline for future comparisons. The type of distinction has been emphasized since the crisis in the ILAE Commission Report in 1981, and classifications of syndromes/epilepsies were published in 1985, 1989, 2010, 2013, and 2017. Epileptic

seizures are classified according to ictal and interictal EEG expression. They are defined as focal (formerly partial) and generalized seizures, whereas syndromes are defined as an epileptic disorder characterized by a set of signs and symptoms that usually occur together [28–31].

Most of the patients could be evaluated clinically, as well as by EEG and imaging, which allowed us to determine that in most of them, hippocampal sclerosis was associated with their epilepsy. Hippocampal sclerosis can be bilateral in 48–56% of patients [32]. The advantage found was that most patients could undergo MRI, a sensitive technique that can be used to detect it [33]. Another cause of epilepsy found in the population was cysticercosis, which, unfortunately, was frequent, although in a much lower proportion than has been reported by others [34]. Cranio-encephalic trauma was the cause in 5% of the cases, which contrasts with other studies that report between 10% and 20% [12]. Vascular disease was also found in 5% of the population studied, although, in epidemiological studies, stroke is associated with 10% as a cause of epilepsy [35]. A cortical dysplasia was found in 4% of the cases, although it could not be a more in-depth study because very few of the cases could reach epilepsy surgery [36].

The primary focus of this analysis was on how reasonable seizure control was achieved by following a guided process in the management of the patients, so an attempt was made to adjust the drugs by seizure type and weight, seeking to achieve seizure freedom with a single drug and trying to convince the patient of the importance of adherence. Among patients receiving monotherapy with good treatment adherence, seven out of ten (70%) achieved seizure freedom, while those who did not adhere to treatment rarely achieved control despite polytherapy. Adequate drug selection and weight-adjusted dosing were based on recommended mg/kg/day ranges from published guidelines, although serum levels were not available to confirm pharmacokinetic adequacy. No significant differences were found by sex. Although adherence was assessed through self-reporting, which may be subject to bias, it was the only feasible method in our resource-limited setting, and no serum drug levels were available. These results are consistent with previous studies demonstrating the importance of guideline adherence in epilepsy management [37–41].

Several limitations should be acknowledged in interpreting these findings. First, the cross-sectional design prevents the establishment of causal relationships between guideline adherence and seizure outcomes. Second, the use of historical data from 2013 may not reflect current practice patterns, although the fundamental principles of epilepsy management remain relevant. Third, our definition of seizure freedom (≥ 3 months) may overestimate rates compared to ILAE's recommended 12-month threshold. Fourth, self-reported adherence measures are subject to recall and social desirability bias. Fifth, the absence of serum drug level monitoring is a significant limitation, especially when interpreting dose adequacy and adherence. Finally, the single-center design may limit the generalizability of the findings to other healthcare settings. In summary, based on our findings and institutional context, we can conclude:

a) Epilepsy is a condition that has multiple etiologies and forms of presentation.

b) Seizures may be focal, generalized, or mixed in onset, although they are not always easy to define clinically.

c) Treatment can be best selected based on the type of seizure to convince the patient of the importance of adhering to the treatment plan. The clinician should adjust the dosage according to the patient's weight.

d) Having a well-maintained electronic database can provide us with critical information on the effectiveness of the management that was administered, based on achieving statistical significance rather than just a subjective interpretation of the results obtained.

Abbreviations

ASMs: antiseizure medications

CIs: confidence intervals

CT: computed tomography

EEG: electroencephalogram

ILAE: International League Against Epilepsy

MRI: magnetic resonance imaging

ORs: odds ratios

TBI: traumatic brain injury

χ^2: chi-squared tests

Declarations

Author contributions

RCCR: Conceptualization, Investigation, Writing—original draft. HGHR: Validation, Methodology, Writing—review & editing. IRL: Conceptualization, Writing—review & editing, Supervision.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical approval

The research was approved by the Ethics and Research Committee of "Dr. Ignacio Morones Prieto" Central Hospital with registration number 129-13. This study complies with the Declaration of Helsinki (version 2013, Fortaleza, Brazil).

Consent to participate

This study utilized secondary data from an institutional database of patients diagnosed with Epilepsy. The information used was fully anonymized and de-identified before analysis. No personal identifiers (such as names, medical record numbers, or contact details) were accessed or recorded at any stage of the research process. Since the data were analyzed in an aggregate form, no direct contact with participants was required. Since there was no access to sensitive or identifying information, individual informed consent was not required by ethical standards and relevant institutional and national guidelines on research with anonymized data.

Consent to publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request, subject to institutional privacy policies.

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