Epilepsy & Behavior 70 (2017) 50–56

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

Potentially preventable complications in epilepsy admissions: The "weekend effect"

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ARTICLE INFO

Article history:
Received 5 January 2017
Revised 26 February 2017
Accepted 4 March 2017
Available online 12 April 2017

Keywords:
Epilepsy
Hospital acquired conditions
Epidemiology
Nationwide Inpatient Sample

ABSTRACT

Introduction: Epilepsy affects approximately 1% of the population in the United States with frequent hospital admissions accounting for a significant burden on patients and society as a whole. Weekend admissions have generally been found to have poorer outcomes compared to weekday admissions with increased rates of preventable complications, such as nationally identified "hospital-acquired conditions" (HAC).
Objective: This study aimed to assess the impact of weekend admission on HACs and mortality in the adult epilepsy population.
Participants: All adult patients with epilepsy hospitalized in the U.S. from 2000 to 2010 in the Nationwide Inpatient Sample.
Results: There were 12,997,181 admissions for epilepsy with 10,106,152 (78%) weekday, 2,891,019 (22%) weekend, and 10 (<0.1%) missing admissions. Weekend admissions saw a 10% increased likelihood of both HACs (RR = 1.10, 95% CI:1.09, 1.11, $p < 0.01$) and mortality (RR = 1.10, 95% CI: 1.09, 1.11, $p < 0.01$) compared to weekday admissions. The occurrence of HAC was associated with higher inpatient charges (RR = 1.36, 95% CI: 1.35, 1.36, $p < 0.01$), pLOS (RR = 1.21, 95% CI: 1.21, 1.22, $p < 0.01$), and higher mortality (RR = 1.13, 95% CI: 1.12, 1.14, $p < 0.01$).
Conclusion: Prior studies have shown weekend admissions are usually associated with higher rates of complications leading to higher costs and a longer hospital stay. Likewise, weekend admissions for epilepsy were associated with increased rates of HACs and mortality; however, they were also negatively associated with LOS and total charge. Thus, weekend admissions for epilepsy should be considered high risk with greater effort made to mitigate these risks.

1. Introduction

It is estimated that approximately 2.5 million people, or 1% of the U.S. population, suffer from epilepsy [1,2]. With a high prevalence, high morbidity, and low mortality, this disease carries a significant chronic burden to patients, family, and society at large [3]. In recent years, the number of interventions for epilepsy has grown with advances in diagnostic technology and the development of novel therapies; however, epilepsy remains a substantial economic burden in the United States on both patients and hospital systems. In 2005, approximately 277,000 hospital stays had epilepsy or convulsions as the principal reason for hospitalization, totaling nearly $1.8 billion in hospital costs [4].

With such high costs and morbidity associated with hospitalizations, it is essential to identify factors associated with adverse outcomes in this population in an effort to decrease economic and physical impact on these patients. Using national discharge databases, like the Nationwide Inpatient Sample and Kids' Inpatient Database, multiple studies have assessed the impact of weekend admissions on the short term outcomes in various other diagnoses [5–7]. This "weekend effect" is associated with an increase in complications due to limitations in hospital resources and staff training [6,8,9]. Previous work has shown that persons admitted over the weekend for certain time-sensitive conditions, including strokes or myocardial infarcts, have an increased risk of "never events", or hospital-acquired conditions (HAC), compared with similar counterparts admitted on weekdays, as well as worse mortality, length of stay (LOS), thrombolytic use, and hospital charges [10–12].

Given the cost of a hospital stay, any prolonged LOS (pLOS), morbidity, or mortality due to preventable causes is crucial to identify and minimize. While this phenomenon has been studied extensively in the surgical/

Abbreviations: HAC, Hospital Acquired Conditions; NIS, Nationwide Inpatient Sample; LOS, length of stay; pLOS, prolonged length of stay.

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http://dx.doi.org/10.1016/j.yebeh.2017.03.008
1525-5050/

procedural fields, there have been few studies associated with admissions related to chronic conditions. We postulate that this "weekend effect" may be a contributor to epilepsy burden through increased costs and preventable complications. In this study, we used the Nationwide Inpatient Sample (NIS) database to evaluate the effect of weekend admissions on both patient and hospital burden throughout the United States, evaluating clinical and services-related outcomes using inpatient mortality and HACs, respectively, as proxies.

2. Methods

2.1. Data

Discharge data from the 2000 to 2010 abstracts of the Nationwide Inpatient Sample (NIS) were utilized in this study. The NIS is one of the largest all payer inpatient discharge databases in the United States, capturing 20% of all U.S. hospital discharges. This database is assembled annually by the Agency for Healthcare Quality and Research's Healthcare Utilization Project. As of 2010, the database consisted of approximately eight million annual discharges, 1000 hospitals, and covered 96% of the U.S. population [13]. The NIS also contains a system of weights based on sampling stratification that allows for the calculation of national estimates [13].

2.2. Study population

For the present study, discharge data were abstracted from the 2000 to 2010 segments of the NIS. Patients were selected using International Classification of Disease Ninth Edition Clinical Modification codes (ICD-9CM) for the various epilepsy codes in the diagnosis fields of NIS. Patients hospitalized with the following diagnosis codes were included in our study: generalized non-convulsive epilepsy (345.00–345.01), generalized convulsive epilepsy (345.10–345.11), petit mal status (345.2), grand mal status (345.3), focal partial epilepsy and epileptic syndromes with complex partial seizures (345.40–345.41), focal partial epilepsy and epileptic syndromes with simple partial seizures (345.50–345.51), infantile spasms (345.60–345.61), epilepsia partialis continua (345.70–345.71), other forms of epilepsy or recurrent seizures (345.80–345.81), unspecified epilepsy (345.90–345.91), and other convulsions (780.39) (Table 1). The NIS does not include unique patient identifiers, therefore each discharge was treated as an independent event, and it is impossible to determine repeat hospitalization in this database.

The NIS includes patient, hospital, and severity demographics that were utilized in the univariate and multivariable analyses. Patient factors included: race (White, Black, Hispanic, Asian/Pacific Islander, Native American, Other), payer information (Medicare, Medicaid, Private Insurance, No Charge, Self-Pay, Other), and gender (male, female). Patient age was categorized from a continuous variable in NIS into groups (18–30 years old, 31–40 years old, 41–50 years old, 51–64 years old, 65–80 years old, older than 80 years old). The NIS hospital factors that were utilized in analysis included: bed size (small < 200, medium 201–400, large > 400 beds), teaching status (non-teaching, teaching), hospital region (Northeast, Midwest, South, West), and location (urban, rural). To account for the heterogeneous nature of admissions, admission severity was determined using two variables: admission type (urgent, elective, newborn, trauma center, other) and admission source (emergency department, another hospital, another health facility including long-term care, court/law enforcement, and routine). Length of stay and total charges were included as continuous variables within NIS. Total inpatient charges were adjusted for inflation to 2013 dollars.

2.3. Outcomes

This study had two primary outcomes of interest: occurrence of HACs and inpatient mortality. HACs were identified using ICD-9CM codes and verified with literature from CMS and prior studies utilizing HACs (Table 2) [14]. Inpatient mortality was identified within NIS by discharge disposition variables. Secondary outcomes of interest included prolonged LOS (pLOS) and higher inpatient charges. To assess the risk of weekend admission on these continuous variables, they were dichotomized against a normalized pLOS (≥50th percentile, ≥4 days) and higher inpatient charges (≥50th percentile, ≥$18,761.48).

2.4. Analysis

Demographic analyses were conducted using survey-adjusted univariate analyses for all patient, hospital, and severity demographic factors to describe the sample population. Multivariable Poisson regression models were used to model the primary and secondary outcomes. The primary exposure of interest was the timing of admission (weekend versus weekday-weekend admission defined as Saturday or Sunday).

Table 1
Frequency of weekend admissions in patients with epilepsy diagnoses.

Epilepsy Dx	ICD-9CM code	No. (%) of all epilepsy diagnoses	No. with weekend admission (%)	No. w/ HACs (%)
Generalized non-convulsive epilepsy without intractable epilepsy	345.00	34,633 (0.3)	6486 (18.7)	1840 (5.3)
Generalized non-convulsive epilepsy with intractable epilepsy	345.01	3500 (0.03)	470 (13.4)	117 (3.3)
Generalized convulsive epilepsy without intractable epilepsy	345.10	206,691 (1.6)	48,816 (23.6)	12,213 (5.9)
Generalized convulsive epilepsy with intractable epilepsy	345.11	18,508 (0.1)	2517 (13.6)	550 (3.0)
Petit mal status	345.2	3284 (0.03)	609 (18.5)	205 (6.2)
Grand mal status	345.3	232,647 (1.8)	61,870 (26.6)	11,994 (5.2)
Focal partial epilepsy and epileptic syndromes with complex partial seizures without intractable epilepsy	345.40	63,809 (0.5)	11,880 (18.6)	2750 (4.3)
Focal partial epilepsy and epileptic syndromes with complex partial seizures with intractable epilepsy	345.41	37,167 (0.3)	2169 (5.8)	410 (1.1)
Focal partial epilepsy and epileptic syndromes with simple partial seizures without intractable epilepsy	345.50	109,043 (0.8)	22,156 (20.3)	5223 (4.8)
Focal partial epilepsy and epileptic syndromes with simple partial seizures with intractable epilepsy	345.51	24,965 (0.2)	2573 (10.3)	476 (1.9)
Infantile spasm without intractable epilepsy	345.60	215 (2E-3)	45 (20.9)	0 (0.0)
Infantile spasm with intractable epilepsy	345.61	67 (5E-4)	5 (7.5)	0 (0.0)
Epilepsia partialis without intractable epilepsy	345.70	14,606 (0.1)	3554 (24.3)	862 (5.9)
Epilepsia partialis continua with intractable epilepsy	345.71	2441 (0.02)	573 (23.5)	81 (3.1)
Epilepsy NEC without intractable epilepsy	345.80	63,067 (0.5)	14,019 (22.2)	3528 (5.6)
Epilepsy NEC with intractable epilepsy	345.81	9322 (0.07)	1213 (13.0)	251 (2.7)
Epilepsy NOS without intractable epilepsy	345.90	293,8174 (22.5)	643,225 (21.9)	205,821 (7.0)
Epilepsy NOS with intractable epilepsy	345.91	54,487 (0.4)	7494 (13.8)	1765 (3.2)
Convulsions NEC	780.39	9,221,161 (70.7)	2,069,465 (22.4)	544,628 (5.9)
Total epilepsy diagnoses*	13,037,787			

* Total number of diagnoses is higher than the total number of patient admissions because pts. can have >1 diagnosis in a given admission.