Epilepsy & Behavior 95 (2019) 148–153

Contents lists available at ScienceDirect

Epilepsy & Behavior

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

Seizure comorbidity boosts odds of 30-day readmission after an index hospitalization for sepsis☆

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ARTICLE INFO

Article history:
Received 28 November 2018
Revised 18 February 2019
Accepted 28 February 2019
Available online 2 May 2019

Keywords:
Risk factors
Epilepsy
Morbidity
Predictors

ABSTRACT

Objective: The objective of this study was to evaluate the association between comorbid seizures and hospital readmissions within 30 days following an index hospitalization for sepsis.
Methods: We analyzed data from 445,489 adult discharges derived from the 2014 National Readmission Database, to evaluate the association of an *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis of seizure during an index hospitalization for sepsis and 30-day readmission rates. We excluded patients who died during hospitalization and those who had missing information on the length of stay or were discharged in December 2014. Prespecified groups were compared by their 30-day readmission and seizure status. We applied a multivariable logistic regression analysis to assess the independent association between seizure and readmission.
Results: Nearly one out of 15 patients discharged with a primary diagnosis of sepsis had comorbid seizures, of which 97% were status epilepticus. Patients with sepsis and comorbid seizures were 30% more likely to be readmitted within 30-days postdischarge, compared to those with sepsis and no comorbid seizures. Additional factors associated with a significantly higher risk for hospital readmission included male sex, age 45–84 years, increased length of stay and cost of primary admission, greater medical comorbidities, and discharge destination. Patients with seizures during their index hospitalization were significantly more likely to have also had a concurrent stroke or the central nervous system (CNS) infection compared with patients without seizures.
Conclusions: Seizures are not uncommon, and patients with sepsis and comorbid seizures are 30% more likely to be readmitted within 30-days postdischarge, compared to those with sepsis and no comorbid seizures.

1. Introduction

Sepsis is a life-threatening organ dysfunction due to an unrestrained systemic inflammatory response to a diagnosed or suspected infection [1]. Of all primary diagnoses for hospital admissions in the United States, it is among the most common and costly [2–4]. Neurological manifestations may occur in up to 70% of patients with sepsis and may include sepsis-associated encephalopathy, stroke, and seizure [5–7]. While, patients who have survived sepsis are at a high risk for substantial and permanent cognitive impairment, as well as functional disability with significant healthcare costs [8,9]. To the best of our knowledge, there is little previously published research specifically on the rate of seizures among those hospitalized with sepsis. However, two previous retrospective studies found that approximately 11–16% of patients with severe sepsis had electrographic seizures on continuous electroencephalography monitoring [10,11].

Up to 26% of survivors of sepsis are readmitted to the hospital within 30-day postdischarge, which is substantially higher than other common conditions requiring hospitalization [12–15]. Readmissions among sepsis survivors have a high mortality risk and contribute to a significant healthcare cost burden in the United States [15]. Previously identified risk factors for readmission include medical comorbidities, age, sex, and discharge destination [16]. Since patients with sepsis are at an increased risk for seizures and that seizures are associated with high rates of hospitalizations, we conjectured that patients with a primary diagnosis of sepsis who had comorbid seizures may be at an increased risk for early readmission [17].

As far as we know, no published study has tested this hypothesis. As such, we analyzed data from the largest and nationally representative

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
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https://doi.org/10.1016/j.yebeh.2019.02.030
1525-5050/

database of hospital readmissions to evaluate the association of comorbid seizure on the rate of 30-day readmissions among patients who were discharged with a primary diagnosis of sepsis.

2. Methods

2.1. Data source and sample

The study population consisted of adult patients (ages 18 years and above) discharged with a primary diagnosis of sepsis. Patients who died during hospitalization, had missing information on the length of stay (LOS), or were discharged in December were excluded as the 30-day readmission does not compute the index event for these individuals. The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes were used to identify adults with primary diagnosis of sepsis (ICD-9-CM codes 038.0, 038.1, 0.38.2, 0.38.3, 038.4, 0.38.8, 0.38.9, 995.92, 995.91, 003.1, 020.2, 022.3, 036.2, 036.3, 054.5, 098.89, 112.5, and 785.52) as described in prior studies [18,19]. A total of 445,489 (weighted sample of 950,423) adults with sepsis (ages 18 years and above) from the 2014 Nationwide Readmission Database (NRD) were included in this analysis. The NRD is derived from State Inpatient Databases (SID), which are samples of hospitals from each state with admission, and discharge data, which are compiled to generate a national estimate of readmissions. In 2014, the NRD was constructed from 22 SID; these states are geographically dispersed and account for 51% of the total US resident population and 49% of all US hospitalizations. The NRD for 2014 contains an unweighted 14.9 million discharges (weighted 35.3 million discharges) in the United States. The database was developed through a Federal State-Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ) to create national estimates of hospital readmissions. Data contained within the NRD include deidentified information of each hospitalization and demographic characteristic, comorbidities, admission status, ICD-9-CM diagnosis and procedures, payer information, time to discharge, hospital characteristics, and cost of hospitalization. Thus, this study is exempted from Institutional Review Board.

2.2. Variables of interest

The primary independent variable was the presence or absence of seizures during the index hospitalization, identified using the following secondary discharge diagnosis codes: 780.39 and 345.x [20,21], which also included diagnosis codes for status epilepticus related (345.2, 345.3 and 345.7). The following covariates were included in the analysis: age (18–44 years (young adults), 45–64 years (adults), 65–84 years (the elderly), ≥ 85 years (the oldest old)), sex, primary payer (Medicare, Medicaid, private, self-pay/no charge/other), hospital bed size (small, medium, large), location/teaching status of hospital (rural, urban nonteaching, urban teaching), admission day (weekday, weekend), patient disposition after discharge from the index hospitalization (routine, transfer to another hospital, other transfers, home healthcare, left against medical advice), median household income for patient's ZIP code (quartile 1, quartile 2, quartile 3, quartile 4), hospital control/ownership (public, private, private investor owned), LOS for the index hospitalization, quartile hospitalization cost, and admission type (elective, nonelective). The primary outcome was a binary variable of readmission within 30 days. Comorbid conditions were quantified using the modified version of Charlson Comorbidity Index (CCI), which is a weighted score of 17 conditions. The CCI is an aggregate of 17 weighted conditions including weight 1: myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, and diabetes; weight 2: hemiplegia, moderate or severe renal disease, diabetes with end organ damage, any tumor, leukemia, lymphoma; weight 3: moderate or severe liver disease; and weight 6: acquired immune deficiency syndrome (AIDS) and metastatic solid tumor [22]. The CCI was grouped into three categories of totaled scores: 0, 1, and ≥ 2. The occurrence of stroke was identified using ICD-9-CM codes for ischemic stroke (433.x1, 434.x1, and 436), hemorrhagic stroke (430, 431, 432.0, 432.1, and 432.9), and intracerebral hemorrhage (431) [23]. Meningitis was identified using codes 320.1 to 322.9 [24]. While, cerebral abscess was identified using codes 324.0 or 324.9, and encephalitis was identified with code 323.9 [24].

2.3. Statistical analysis

We used Chi-square tests to compare demographic and clinical variables by seizures status (seizures vs. nonseizures) and by readmission status (readmitted within 30 days vs. nonreadmitted within 30 days). A multivariable logistic regression model was applied to ascertain the independent association between readmission and seizures. A sensitivity analysis that repeated the logistic regression using diagnostic codes for status epilepticus exclusively was also performed. Odds ratios (ORs) and respective 95% confidence intervals (CI) of the predictors of readmission within 30 days were reported. In this analysis, we accounted for complex survey design (clustering, stratification, and weighting) to generalize the results to the US population. For complex survey design, the variance inflation factor test revealed that no multicollinearity problems existed between predictors of the logistic regression model and the link test used as a diagnostic test to examine the model specification error, verified evidence of proper specification of the model [25]. All analyses were performed using Stata ver.14 software (StataCorp LP College Station, TX). The value of $p < 0.05$ was considered significant and discussed in this paper.

3. Results

There were a total of 445,489 adult patients (weighted 950,423) with a primary discharge diagnosis of sepsis (Table 1), including 6.19% (27,992) with seizures of which 97.1% (27,189) were status epilepticus. Patients with seizures were more likely to be in the age groups of 18–44 years and 45–64 years, of male sex, Medicare and Medicaid insured, admitted to urban nonteaching hospitals, transferred to another hospital or other transfers, of a median household income in the first quartile, diagnosed with fewer comorbidities and admitted nonelectively. The average LOS of those with seizures was more likely to be equal to or greater than 7 days compared to those without seizure (51.9% vs. 38.2%, $p < 0.001$). Those with seizures were also more likely to have a readmission within 30 days after discharge ($p < 0.001$).

Encephalitis and meningitis, respectively, were present among 0.22% ($p < 0.001$) and 0.80% ($p < 0.001$) of those with seizures compared to 0.05% and 0.26% of those without comorbid seizures (Table 2). While, cerebral abscess was present in 0.14% ($p < 0.001$) of patients with comorbid seizures compared to 0.04% of those who did not. Stroke occurred in 13.91% ($p < 0.001$) of patients with comorbid seizures but only in 4.94% of patients without seizures.

Patients with a primary discharge diagnosis of sepsis and readmitted within 30 days (Table 3) after discharge were more likely to be in the age groups of 65–84 years and above 85 years, of male sex, Medicare and Medicaid insured, admitted to an urban nonteaching hospital, of discharge disposition other than routine, and admitted nonelectively. Patients discharged with a diagnosis of sepsis and readmitted within 30 days had longer hospitalization and more medical comorbidities.

In the multiple logistic regression analysis (Table 4), patients with sepsis with comorbid seizures were 30% (OR: 1.30, 95% CI: 1.21–1.37) more likely to be readmitted within 30 days postdischarge, compared to patients with sepsis and no comorbid seizures. Additional factors associated with an increased odds of 30-day readmission included the age groups 45–64 years (OR: 1.21, 95% CI: 1.13–1.30) and 65–84 years (OR: 1.15, 95% CI: 1.06–1.24), hospital LOS greater than 7 days (OR: 1.25, 95% CI: 1.11–1.42), increased medical comorbidities (CCI score of 1 vs. 0, OR: 1.17, 95% CI: 1.11–1.23; CCI score of 2 or more vs. 0, OR: 1.37, 95% CI: 1.31–1.43), and increased quartile cost of primary admission (quartile 2 vs. 1, OR: 1.33, 95% CI: 1.25–1.40; quartile 3 vs. 1,

Table 1
Sample demographics and clinical characteristics among adult patients with sepsis with and without comorbid seizures.

Variables	All (%)	Seizure (%)	No seizure (%)	p-Value
N(n)	950,423 (445,489)	58,833 (27,992)	891,590 (417,497)	
Age category				
Age 18–44 years	13.8	18.5	13.5	<0.001
Age 45–64 years	30.1	37.5	29.6	
Age 65–84 years	40.8	34.8	41.2	
Age 85+ years	15.3	9.2	15.7	
Sex				
Male	48.8	52.0	48.5	<0.001
Female	51.2	48.0	51.5	
Primary payer				
Medicare	64.4	67.7	64.2	<0.001
Medicaid	12.5	18.8	12.0	
Private	17.1	9.5	17.6	
Self-pay/no charge/others	6.0	4.0	6.2	
Hospital bed size				
Small	17.0	16.0	17.1	0.179
Medium	28.5	28.5	28.5	
Large	54.5	55.5	54.4	
Urban-teaching status				
Urban nonteaching	29.1	29.6	29.0	<0.001
Urban teaching	59.6	60.8	59.5	
Rural	11.3	9.6	11.5	
Admission day				
Week day	73.7	72.6	73.7	<0.001
Weekend	26.3	27.4	26.3	
Patient disposition				
Routine	45.2	31.7	46.1	<0.001
Transfer to another hospital	1.8	2.3	1.8	
Other transfers	32.3	47.3	31.3	
Home healthcare	19.5	17.6	19.6	
Against medical advice	1.2	1.1	1.2	
Median household income for patient's ZIP code				
Quartile 1	27.8	30.6	27.6	<0.001
Quartile 2	27.3	26.8	27.3	
Quartile 3	23.8	21.8	23.9	
Quartile 4	21.1	20.8	21.2	
Hospital control/ownership				
Government nonfederal(public)	10.2	10.1	10.2	0.018
Private (not for profit)	77.4	76.4	77.5	
Private investor owned	12.4	13.5	12.2	
LOS				
≤ 1 day	4.1	2.6	4.2	<0.001
2–6 days	57.1	48.7	57.6	
≥ 7 days	38.8	48.7	38.2	
Charlson Comorbidity index (CCI)				
0	26.3	27.9	26.2	<0.001
1	25.5	24.8	25.6	
≥ 2	48.2	47.3	48.2	
Admission type				
Nonelective	97.0	97.8	96.9	<0.001
Elective	3.0	2.2	3.1	
Readmission within 30 days				
No	95.4	93.3	95.6	<0.001
Yes	4.6	6.7	4.4	

N, weighted sample size; n, unweighted sample size; %, weighted percentage.

Table 2
Secondary diagnoses among patients with and without comorbid seizure during index hospitalization for sepsis.

Comorbidity	All (%)	Seizure (%)	No seizure (%)	p-Value
N(n)	950,423 (445,489)	58,833 (27,992)	891,590 (417,497)	
Encephalitis	0.06	0.22	0.06	<0.001
Cerebral abscess	0.04	0.14	0.04	<0.001
Meningitis	0.29	0.80	0.26	<0.001
Stroke	5.49	13.91	4.93	<0.001

N, weighted sample size; n, unweighted sample size; %, weighted percentage.

Table 3
Sample demographics and 30-days readmission rates among adult patients with sepsis.

Variables	All (%)	30 days readmission (%)	No 30 days readmission (%)	p-Value
N(n)	950,423 (445,489)	43,550 (21,386)	906,873 (424,103)	
Age category				
Age 18–44 years	13.8	8.7	14.1	<0.001
Age 45–64 years	30.1	28.9	30.1	
Age 65–84 years	40.8	46.4	40.6	
Age 85+ years	15.3	16.0	15.2	
Sex				
Male	48.8	51.0	48.7	<0.001
Female	51.2	49.0	51.3	
Primary payer				
Medicare	64.4	73.6	64.0	<0.001
Medicaid	12.5	12.7	12.4	
Private	17.0	10.6	17.4	
Self-pay/no charge/others	6.1	3.1	6.2	
Hospital bed size				
Small	17.0	15.8	17.1	0.116
Medium	28.5	29.9	28.4	
Large	54.5	54.3	54.5	
Urban-teaching status				
Urban nonteaching	29.1	31.0	29.0	0.001
Urban teaching	59.6	59.6	59.6	
Rural	11.3	9.4	11.4	
Admission day				
Week day	73.7	74.0	73.6	0.253
Weekend	26.3	26.0	26.4	
Patient disposition				
Routine	45.2	28.1	46.0	<0.001
Transfer to another hospital	1.8	2.4	1.7	
Other transfers	32.3	48.1	31.6	
Home healthcare	19.5	20.1	19.5	
Against medical advice	1.2	1.3	1.2	
Median household income for patient's ZIP code				
Quartile 1	27.7	28.1	27.7	0.466
Quartile 2	27.3	27.2	27.3	
Quartile 3	23.8	23.0	23.8	
Quartile 4	21.2	21.7	21.2	
Hospital control/ownership				
Government nonfederal(public)	10.2	9.4	10.3	0.079
Private (not for profit)	77.4	78.4	77.4	
Private investor owned	12.4	12.2	12.3	
LOS				
≤ 1 day	4.2	2.5	4.2	<0.001
2–6 days	57.0	45.6	57.6	
≥ 7 days	38.8	51.9	38.2	
Charlson Comorbidity index (CCI)				
0	26.3	18.6	26.7	<0.001
1	25.5	23.7	25.6	
≥ 2	48.2	57.7	47.7	
Hospital cost				
Quartile 1	25.9	15.2	26.4	<0.001
Quartile 2	25.3	23.0	25.4	
Quartile 3	24.8	28.2	24.6	
Quartile4	24.0	33.6	23.6	
Admission type				
Nonelective	97.0	97.6	96.9	<0.001
Elective	3.0	2.4	3.1	

N, weighted sample size; n, unweighted sample size; %, weighted percentage.

OR: 1.43, 95% CI: 1.34–1.53; quartile 4 vs. 1, OR: 1.53, 95% CI: 1.41–1.66). Factors associated with decreased odds of 30-day readmission included female sex (OR: 0.92, 95% CI: 0.89–0.95), insurance type (self-pay vs. Medicare, OR = 0.62; 95% CI: 0.56–0.69; private vs. Medicare, OR = 0.66; 95% CI: 0.61–0.71), hospital type (urban nonteaching vs. rural, OR = 0.83, 95% CI: 0.73–0.94), and elective admission (OR: 0.83, 95% CI: 0.73–0.94). Finally, disposition was independently associated with the odds of 30-day readmission in patients with sepsis (short to short-term hospital vs. routine, OR: 1.86, 95% CI: 1.59–2.17; other transfers vs. routine, OR: 1.91, 95% CI: 1.75–2.09; home healthcare vs. routine, OR: 1.36,

Table 4
Adjusted multivariable logistic regression for 30-day readmission among adult patients with an index hospitalization for sepsis with comorbid seizures.

Variables	Odds ratio	95% CI	p value
Primary independent variable			
No seizure (Ref.)	–	–	–
Seizure	1.30***	1.21–1.37	<0.001
Covariates			
Sex			
Male (Ref.)	–	–	–
Female	0.92***	0.89–0.95	<0.001
Age category			
Age 18–44 years (Ref.)	–	–	–
Age 45–64 years	1.21***	1.13–1.30	<0.001
Age 65–84 years	1.15**	1.06–1.24	0.001
Age 85 + years	1.01	0.92–1.11	0.775
Primary payer			
Medicare (Ref.)	–	–	–
Medicaid	1.04	0.97–1.11	0.236
Private	0.66***	0.61–0.71	<0.001
Self-pay/no charge/others	0.62***	0.56–0.69	<0.001
Hospital bed size			
Small (Ref.)	–	–	–
Medium	1.09	0.97–1.24	0.132
Large	1.03	0.95–1.10	0.429
Urban-teaching status			
Urban nonteaching (Ref.)	–	–	–
Urban teaching	0.92	0.83–1.03	0.171
Rural	0.83**	0.73–0.94	0.005
Admission day			
Week day (Ref.)	–	–	–
Weekend	0.98	0.95–1.02	0.438
Patient disposition			
Routine (Ref.)	–	–	–
Transfer to another hospital	1.86***	1.59–2.17	<0.001
Other transfers	1.91***	1.75–2.09	<0.001
Home healthcare	1.36***	1.26–1.48	<0.001
Against medical advice	1.90***	1.68–2.16	<0.001
Income			
Quartile 1 (Ref.)	–	–	–
Quartile 2	0.97	0.92–1.04	0.502
Quartile 3	0.94	0.87–1.01	0.142
Quartile 4	0.97	0.89–1.06	0.609
Hospital control/ownership			
Government nonfederal(public) (Ref.)	–	–	–
Private (not for profit)	1.07	0.98–1.17	0.103
Private investor owned	0.97	0.86–1.08	0.610
LOS			
≤ 1 day (Ref.)	–	–	–
2–6 days	1.08	0.96–1.21	0.168
≥ 7 days	1.25***	1.11–1.42	<0.001
Charlson Comorbidity index (CCI)			
0 (Ref.)	–	–	–
1	1.17***	1.11–1.23	<0.001
≥ 2	1.37***	1.31–1.43	<0.001
Hospital cost			
Quartile 1 (Ref.)	–	–	–
Quartile 2	1.33***	1.25–1.40	<0.001
Quartile 3	1.43***	1.34–1.53	<0.001
Quartile 4	1.53***	1.41–1.66	<0.001
Admission type			
Nonelective (Ref.)	–	–	–
Elective	0.83**	0.73–0.94	0.004

* Level of significance $p < 0.05$; ** level of significance $p < 0.01$; ***level of significance $p < 0.001$.

95% CI: 1.26–1.48; against medical advice vs. routine, OR: 1.90, 95% CI: 1.68–2.16). Results of logistic regression analysis examining the independent association of seizure with 30-day readmission and limited to patients with status epilepticus can be found in supplementary Table 1. The strength of association between status epilepticus and 30-day readmission was similar to that derived from the general population of patients with sepsis and seizures.

4. Discussion

We found that almost one out of 15 patients discharged with a primary diagnosis of sepsis had comorbid seizures. We also found 30% higher odds of 30-day readmission among patients discharged with a primary diagnosis of sepsis and comorbid seizure. The relationship between seizures and sepsis is still incompletely understood. However, there is increasing epidemiological data suggesting that sepsis is an independent risk factor for seizures [7]. Mechanistic links between sepsis and seizures include disruption of the blood–brain barrier, neuroinflammation, apoptosis, and mitochondrial dysfunction, commonly found in patients with sepsis [26–29]. Strokes among hospitalized patients with sepsis have been demonstrated to occur more frequently relative to other patients admitted to the hospital [30]. Our results suggest that patients with concurrent sepsis and stroke are more likely to have had seizures than patients without stroke. Thus, stroke may be a contributing factor for the development of seizures among patients hospitalized with sepsis. In addition, central nervous system (CNS) infections including encephalitis, meningitis, and cerebral abscess were shown to be more frequent among patients with sepsis and seizures and are also likely responsible for an increased risk for seizures in some patients.

Other factors associated with an increased odd for readmission among patients with sepsis were similar to those that have been previously reported. For instance, patients with a greater number of medical comorbidities as measured by the CCI were at a higher risk for readmission which is consistent with previously reported findings [15,16]. This is likely because the conditions that are measured by the CCI are also associated with frequent hospital admissions [31–33]. In addition, individuals above the age of 85 years were less likely to be readmitted than younger patients, which is consistent with findings in prior studies attributing this effect to change in goals of care with involvement of palliative care [15,34,35]. Also, female sex was associated with a reduced risk for readmission, which is a finding that has been demonstrated previously in patients with sepsis as well as other conditions [15,36]. This has been attributed to secondary factors associated with male sex including being retired, symptoms of depression, being unmarried, and having no primary care physicians (PCP) visit within 30 days of discharge [36]. Additionally, discharge disposition, longer length of hospitalization, increased cost of hospitalization, Medicare or Medicaid insurance, and hospital type were also associated with risk of readmission. These findings may be partially explained by differences in access to care, healthcare literacy and severity of illnesses [37–43].

Most patients in our analysis who were admitted for sepsis and had comorbid seizures had status epilepticus. Previous studies have shown that patients with status epilepticus have prolonged lengths of admissions, high mortality, and hospitalization costs [44–46], while patients with status epilepticus concurrent with an infection tend to have even worse outcomes than those without infections [47]. Thus, these associations may in part explain why patients with sepsis and seizures had increased LOS and hospitalization costs relative to patients without seizures.

Efforts to create accurate risk prediction models for hospital readmissions have been thus far been demonstrated to perform modestly [48–50]. In addition, it has been demonstrated that prediction models tailored for specific disease groups outperform those designed for use in the general population [51]. Furthermore, it has been shown that identification of additional comorbidities may enhance the predictive ability of readmission models [52]. Thus, the identification of seizures as a risk factor for readmission may assist in the future construction of more accurate prediction model. Seizures have been also demonstrated to be a significant risk factor for admission to the hospital among the general population. For instance, 23% of patients who present to the emergency department with seizures are ultimately admitted [53]. While patients who are admitted with a primary diagnosis of epilepsy have been shown to have a 30-day readmission rate of 10.3% of which the most common reason for readmission is recurrent seizures [54]. Among patients

admitted to the hospital with a primary diagnosis of status epilepticus, the 30-day readmission rate is 14.0% of which the most common cause for readmission was also seizures [55]. Thus, increased awareness about seizures and its association with readmission as shown in this study as well as studies that would evaluate the potential impact of early diagnosis and treatment of seizures in patients with sepsis could potentially lead to improved outcomes.

Weaknesses of this study include the potential for coding errors, such as the misdiagnosis of seizure with a nonepileptic paroxysmal event, which is an inherent potential weakness of using large database studies relying on administrative codes. In addition, our results do not distinguish between the causes for readmission, which may be unique among patients with sepsis and seizures. Also, it was not possible to establish whether treatment of seizures may have influenced patient outcome as the database that we used does not contain sufficient details to answer such questions. We were also unable to distinguish between patients with acute-symptomatic seizures and seizures in patients with epilepsy. Strengths of the study include the usage of the largest standardized and validated discharge database within the United States, which enabled us to analyze data from 445,489 discharges.

5. Conclusions

Seizures are common and are associated with increased odds for hospital readmission within 30 days of an index hospitalization for sepsis. Greater awareness about the impact of seizures among patients with sepsis and how it may influence readmission risk is important. Future research evaluating which subpopulations of patients with sepsis are at greater risk for seizures as well as the potential impact of treatment and how it may influence readmission rates will need to be conducted.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.yebeh.2019.02.030.

Declarations of interest

The authors report no relationships that could be construed as a conflict of interest.

Author contributions

Name	Location	Role	Contribution
Jonah Fox, MD	Medical University of South Carolina	Author	study concept and design, drafted the manuscript; data interpretation; and critical revision of the manuscript for important intellectual content.
Alain Lekoubou, MD, MS	Medical University of South Carolina	Author	study concept and design; data interpretation; and critical revision of the manuscript for important intellectual content.
Kinfe G. Bishu, PhD	Medical University of South Carolina	Author	study concept and design; statistical analysis; data interpretation; and critical revision of the manuscript for important intellectual content.
Bruce Ovbiagele. MD, MSc, MAS, MBA	University of California, San Francisco	Author	study concept and design; critical revision of the manuscript for important intellectual content; and study supervision.

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