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Inpatient treatment costs of status epilepticus in adults in Germany

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ABSTRACT

Purpose: Status epilepticus (SE) is an important neurological emergency and a significant source of direct costs related to hospitalization; however, no cost-of-illness (COI) studies have been performed in Europe. The objective of this study was to determine and characterize hospital costs related to the acute inpatient treatment of SE and to provide national estimates of SE hospitalization costs.
Methods: Adult inpatient treatment costs related to SE and costs attributable to epilepsy-related hospital admissions were derived from billing data of participating hospitals.
Results: During the 4-month study period a total of 96 patients (59.5 ± 21.6 years; 52 male) received inpatient treatment for epilepsy-related reasons, 10 of these (10.4%) were treated for SE. Epilepsy was newly diagnosed in 30/96 patients (31.3%), of whom five presented with SE. The admission costs related to SE (€8347 ± 10,773 per patient per admission) were significantly higher than those related to admissions of patients with newly diagnosed (€1998 ± 1089; $p = 0.014$) or established epilepsy (€3475 ± 4413; $p = 0.026$). Of the total inpatient costs (€346,319) 24.4% were attributable to SE, 14.4% to newly diagnosed epilepsy without SE ($n = 25$) and 61.2% to complications of established epilepsy ($n = 61$). Extrapolation to the whole of Germany (population 82 million) indicates that SE causes hospital costs of more than €83 million per year while the total of epilepsy-related inpatient treatment costs amounts to €342 million.
Conclusion: Acute treatment of SE is responsible for a high proportion of hospital costs associated with epilepsy. With a high incidence of SE in the elderly population, the health care systems will face an increasing number of presentations with SE and its associated costs, underlining the necessity to further evaluate the burden and optimize the treatment of SE.

1. Introduction

In 2010 the European Brain Council commissioned a study to evaluate costs of disorders of the brain in Europe.[1] The number of people with epilepsy in Europe was estimated at 2,643,001 with mean annual costs of €-PPP 5221 (PPP = purchasing power parity, 2010 values) per person. Total direct and indirect costs would amount to €-PPP 13.8 billion. The authors stated that status epilepticus (SE) was an important source of direct costs, while noting the complete lack of cost-of-illness (COI) studies evaluating the costs related to SE in Europe.[1]

Given the growing resource utilization and the increasing limitations of available healthcare resources, it has become essential to gather reliable cost estimates as a scientific basis for resource allocation and health policy decision-making. In fact, this has become even more important as the introduction of new intravenous and oral antiepileptic drugs,[2] the rapid expansion of the elderly population and the use of alternative treatments in refractory SE[3] may result in a considerable increase in costs or a shift in the distribution of cost components.[4,5]

Costs caused by epilepsy and SE are closely related. Hospital costs may easily be attributed to epilepsy or SE alone. In contrast long-term sequelae as rehabilitation needs or indirect costs due to loss of productivity cannot be attributed without doubt to SE or epilepsy alone. Thus, the objective of this study was to determine and characterize the total epilepsy and SE related direct inpatient treatment costs. We also aimed to provide national estimates for the acute treatment of SE.

2. Patients and methods

In 2008 we performed a population-based COI study[6] among adult patients with epilepsy in the district of Marburg–Biedenkopf (251,418 inhabitants according to the 2008 census, www.statistik-hessen.de). Only adults >18 years of age were included and further

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data on direct and indirect cost were provided earlier in detail.[6] The population structure in this district is representative of Germany and was used for a population-based estimate of the incidence of SE.[7]

This study was performed by means of a bottom-up approach from the perspective of the statutory health insurer and was granted approval by the local Ethics Committee.

Inpatient care is provided by three district hospitals without neurology departments and the multispecialty tertiary university hospital. The university hospital and two of the district hospitals provide accident and emergency care.

All four hospitals provided cost data on adult patients with a primary or secondary ICD-10 diagnosis of SE (G41.x) or epilepsy (G40.x) who were admitted during the study period of four months. The aim of this study was to calculate the genuine costs due to epilepsy or SE and not costs that may be triggered by other disease not related to epilepsy. Therefore the hospital billing data of each patient were crosschecked with patient files to determine whether or not the hospitalization was due to SE or epilepsy. The epilepsy diagnosis was based on the definitions proposed by the ILAE and the IBE.[9] SE was defined as a single clinical seizure lasting >30 min or repeated seizures over a period of >30 min without intervening recovery of consciousness.[7,10] Only admissions related to epilepsy or SE were evaluated and separated from admissions related to other causes like appendicitis or myocardial infarction when epilepsy was a co-morbidity. Admission due to acute symptomatic/provoked (i.e. alcohol withdrawal) seizures were not included. Hospital-based outpatient care, e.g. treatment in accident and emergency department with discharge on the same day, is reimbursed in Germany as outpatient treatment and was not evaluated in this study.

Inpatient costs were calculated according to German diagnosis related groups (G-DRG; www.g-drg.de).[8] The costs were calculated in 2008 Euro (€) according to German recommendations for performing health economic evaluations as described in previous publications.[6,11] The postal code of each patient's permanent address was used to identify patients living within and outside the district of Marburg–Biedenkopf in order to obtain a population-based estimate of the cost data.

Statistical analyses were performed using IBM SPSS Statistics 20 (SPSS Inc., Chicago, IL, USA). Comparisons between groups were performed using the appropriate parametric and non-parametric tests.

3. Results

3.1. Patient population

During the 4-month study period 145 residents of Marburg–Biedenkopf were hospitalized with a primary or secondary ICD-10 diagnosis of SE or epilepsy. In 96 of these patients (96/145; 66.2%) admission was related to SE or epilepsy. In the other 49 cases epilepsy was a co-morbidity and was not related to the admission.

Table 1 shows the sociodemographic, clinical and cost characteristics of the patients with SE and of the control group (without SE) with newly diagnosed or established epilepsy. Thirteen (13.5%) patients were treated in the three district hospitals and 83 (86.5%) at the tertiary university hospital. All patients were treated only once during the study period.

Admission due to SE was seen in 10/96 patients (10.4%). Epilepsy was newly diagnosed in 30/96 patients (31.3%) and 5 of these patients presented with SE. Among the 61 patients with an established diagnosis the majority of 44 patients (44/61; 72.1%) were admitted due to seizures or side-effects of anticonvulsants, nine (9/61; 14.8%) required hospitalization due to seizure-related fractures and lacerations and six (6/61; 9.8%) were admitted for further diagnostics and treatment within the epilepsy surgery program.

3.2. Characteristics of patients with SE

Table 2 shows the clinical and treatment characteristics of patients with SE. SE was mainly focal (8/10), with (3/10) or without (5/10) secondary generalization. Fifty percent of the patients had a history of epilepsy at the time of the SE. Acute and remote stroke was the most common etiology in half of all patients. Benzodiazepines were used as first-line treatment in the prehospital phase in 6 out of 10 patients. Upon hospital admission benzodiazepines were administered in further three patients. In further course of treatment anticonvulsants were used in all patients, Table 2.

3.3. Inpatient costs

Table 1 shows the costs per hospital admission during the 4-month study period and annual cost estimates: costs of inpatient treatment of SE (€8347 ± 10,773 per patient per admission) were

Table 1
Sociodemographic, clinical and cost characteristics (2008 values).

		Status epilepticus $n=10$	Newly diagnosed epilepsy# $n=25$	Established epilepsy $n=61$	All patients with SE and epilepsy $n=96$
Age in years	Mean ± SD	73.0 ± 15.7	65.5 ±20.4	54.7 ±21.6	59.5 ±21.6
	Median	77	71	49	65
	Range	36–91	23–96	21–93	21–96
Sex		% (n)	% (n)	% (n)	% (n)
Male		70(7)	40 (10)	57.4 (35)	54.1 (52)
Female		30(3)	60 (15)	42.6 (26)	45.8 (44)
Length of hospital stay in days	Mean ± SD	14.0 ± 13.0	5.4 ± 3.5	7.5 ± 7.3	7.6 ± 7.6
	Median	10.5	5	5	5
	Range	1–45	1–14	1–31	1–45
Costs per hospital admission	Mean ± SD	€8347 ± 10,773	€1998 ± 1089	€3475 ± 4413	€3607 ± 5171
	95% CI	€3565–16062	€1583–2438	€2463–4673	€2709–4710
	Minimum	€609	€520	€495	€495
	Median	€4702	€2098	€2098	€2204
	Maximum	€37,647	€4899	€23,145	€37,647
Costs during study period of 4 months		€84,366	€49,955	€211,998	€346,319
Proportion of total hospital costs		24.4%	14.4%	61.2%	
Estimated annual costs (district)		€253,098	€149,865	€635,994	€1,038,956
Estimated annual costs (Germany)		€83.4 Mio	€49.4 Mio	€209.5 Mio	€342.2 Mio

SD: standard deviation; #: without five patients with status epilepticus; SE: status epilepticus; 95% CI: 95% confidence interval using the bootstrap bias corrected and accelerated method.