INTRODUCTION

Epilepsy is a common neurological disorder caused by multiple factors. Stroke is one of the most common causes of unprovoked seizures and thus epilepsy in the elderly population. Acute symptomatic seizures (formerly also termed “early seizures”) occur within 7 days after stroke and unprovoked seizures (formerly also termed “late seizures”) thereafter. The occurrence of at least one unprovoked seizure is required for a clinical diagnosis of epilepsy. Depending on the type of cerebrovascular disease, 8–15% of patients with stroke may develop poststroke epilepsy (PSE), which has a negative impact on stroke prognosis and quality of life.
factors for unprovoked seizures and epilepsy following stroke may include younger age, greater stroke severity, involvement of middle cerebral artery territory, hemorrhagic stroke, and acute symptomatic seizures.\textsuperscript{10-13}

There is no consensus on how to best treat patients with PSE.\textsuperscript{14} Representative data for the treatment of PSE in Germany, particularly AED treatment, are limited. The objectives of this study were to describe the incidence and risk factors of PSE in Germany based on claims data, and to describe outpatient treatment of PSE.

2 | METHODS

2.1 | Overall study design

This retrospective study was based on statutory claims data from AOK PLUS, a German public sickness fund insuring about 3.2 million persons in the states of Saxony and Thuringia. The database contains anonymized patient-level data including demographics, inpatient care (excluding medication), outpatient care, and outpatient medication. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was consistent with Good Epidemiology Practices and applicable regulatory requirements. Because of the noninterventional nature of the study, which analyzed a retrospective anonymized data set only, no ethical vote was needed.

The study period was from 01 January, 2010 to 31 December, 2016 (Figure 1A). Patients who had at least one hospitalization with a main diagnosis of acute stroke (International Classification of Diseases [ICD]-10 I60/I61/I62/I63/I64.-; subarachnoid hemorrhage, intracerebral hemorrhage, other nontraumatic intracranial hemorrhage, cerebral infarction, and stroke not specified as hemorrhage or infarction) were included. The index date was defined as the date of first observed acute stroke hospitalization. To allow for a baseline period of 12 months before and a follow-up time of at least 12 months after index (a shorter follow-up was permitted in case of death), patients with acute stroke between 01 January, 2011 and 31 December, 2015 were eligible for the analyses (Figure 1B). Eligible patients had continuous AOK PLUS insurance throughout the follow-up period, which started at index and lasted until the end of data availability (31 December, 2016) or death. Patients with stroke or an inpatient/outpatient ICD-10 G40.- claim 12 months before the first observed stroke hospitalization were excluded.

A seizure claim was defined as at least one ICD-10 G40.- claim during/after index stroke hospitalization. Seizure claims data do not always indicate a clinical diagnosis of epilepsy; for example, patients may have had acute symptomatic seizures following stroke but may not have developed epilepsy. Seizure claims during index hospitalizations were considered indicative of patients with acute symptomatic seizures, whereas claims after index hospitalization (or multiple claims) were considered indicative of unprovoked seizures/PSE. However, there remains a degree of uncertainty as the exact dates when seizures occurred were unknown (acute symptomatic seizures are defined as seizures occurring within 7 days of stroke, and unprovoked seizures are defined as those occurring after 7 days). ICD-10 R56.8 (other and unspecified convulsions) claims were not analyzed.

FIGURE 1  (A) Study design; (B) patient sample. Cohorts A1-3 are not mutually exclusive. *Except patients who died in <12 months, who were still included
since this code is not specific to epileptic seizures and would not generally be used for acute symptomatic or unprovoked seizures in Germany.

2.2 | Study cohorts

The main cohort (Cohort A) comprised all eligible patients with acute stroke who had at least one seizure claim; Cohort B comprised those without seizure claims (Figure 1B). A subgroup of patients with an index stroke hospitalization between 01 January, 2011 and 31 December, 2011 (follow-up period of 60–72 months, or until death if sooner), was also analyzed (Cohort A-1 [with seizure claim] and Cohort B-1 [without seizure claim]), representing the patients with the longest follow-up times. A sensitivity analysis was performed in a subgroup of patients with at least two seizure claims (during or after index hospitalization) (Cohort A-2). Analyses were also performed in patients with at least one seizure claim during index stroke hospitalization (Cohort A-3).

2.3 | Outcomes

We reported the following outcomes: incidence of PSE, patient characteristics, time from stroke to seizure claim, risk factors for seizure claim after index stroke hospitalization, mortality, and risk factors for death after index stroke hospitalization, neuropsychiatric comorbidities at baseline and follow-up, and treatment of patients with seizure claims.

Incidence of PSE was calculated from the number of eligible stroke patients in the sickness fund (cases per 1000 patient-years) within the first 90/180/365 days of follow-up and over the total follow-up period, and was defined as patients with ≥2 seizure claims (during/after index hospitalization), or ≥1 seizure claim after index hospitalization. Patients who had only one seizure claim during the index hospitalization and no further seizure claims were excluded, since these patients may have had an acute symptomatic seizure but did not develop epilepsy. Reported patient characteristics included age, sex, and Charlson Comorbidity Index (CCI), and description of the index hospitalization (type of stroke [by ICD-10], length of stay, and complexity of stroke treatment). Stroke treatment complexity was based on German inpatient diagnosis-related group (DRG) codes, which are based on several parameters including main diagnosis, codiagnoses, procedures, complications, and length of hospital stay. The codes reflect treatment expenditure, which decreases from A to H.

Kaplan-Meier analysis of time from beginning of the index stroke hospitalization to first seizure claim was used to estimate the risk of seizure claim at specified time points; patients were censored at death and end of observation period. Multivariate Cox-regression analysis of time from index stroke hospitalization discharge to first post-index hospitalization seizure claim was performed to identify factors associated with PSE. Similarly, a multivariate Cox-regression analysis was performed to identify factors associated with early death. Both analyses were performed by stepwise backward elimination of independent variables (p > .1), including sex, age, baseline CCI, seizure claim during index hospitalization (yes/no), number of all-cause hospitalizations during the baseline period, length of index hospital stay (days), type of stroke, and complexity of stroke treatment. For the analysis of early death, seizure claim during index hospitalization was considered as a time-dependent variable. For analysis of time to first seizure claim after index hospitalization discharge, patients were censored at death or end of observation. For analysis of time to death after stroke, patients were censored at end of observation.

Treatment outcomes included details of initial seizure claim and AED treatment during the follow-up period. The first AED regimen recorded in the database was considered to be the first-line treatment. If the patient had claims for different AEDs on the same day, this was assumed to be combination therapy. Addition of an AED (to monotherapy or combination therapy), withdrawal of an AED (from combination therapy), or switch of one or more AEDs all constituted second-line treatment.

Statistical tests were performed using Stata 14 statistical software. As this was a descriptive study, no assessment of required sample size was performed. Due to the retrospective nature of the study, all statistical tests and presented P-values were exploratory; no multiple testing was done. For categorical variables, statistical comparisons to assess differences between groups were conducted using either Chi-square tests or Fisher’s exact test (when the values in any of the cells of a contingency table were below 5). For continuous variables, statistical comparisons were conducted using t tests for variables with a normal distribution in the case of two-sample comparison groups and one-way analysis of variance in the case of multisample comparison groups; Wilcoxon rank sum (nonparametric) tests were used for variables with skewed distribution.

3 | RESULTS

3.1 | Incidence of poststroke epilepsy and characteristics of patients with and without seizure claims

Overall, 58 007 patients in the AOK PLUS database had at least one inpatient stroke diagnosis between 01 January, 2011 and 31 December, 2015, of whom, 53 883 patients were eligible for the analyses, with a mean follow-up period of 829.05 days (median 749 days, Figure 1B).

Overall, 6054 of 53 883 (11.24%) patients with acute stroke had at least one seizure claim (Cohort A, Figure 1). 826 of 53 883 (1.53%) eligible patients had only one seizure claim (during index hospitalization) and no further seizure claims and were excluded from the analysis of incidence of PSE. The incidence of PSE (cases/1000 patient-years) was 190.82 within 90 days after stroke, 135.42 within 180 days, 94.49 within 1 year, and 46.97 within the total follow-up
3.3 | Risk factors for poststroke epilepsy claims

Multivariate Cox-regression analysis in all patients with stroke (N = 53 883) showed that hemorrhagic stroke (HR = 1.13, 95% CI: 1.06–1.21; p < .001) was associated with a higher risk of seizure claim following hospital discharge than cerebral infarction (Table 2). Furthermore, a seizure claim during index hospitalization was a significant risk factor for a seizure claim after discharge (HR = 6.97; 95% CI: 6.53–7.43; p < .001). Age (HR = 0.99; 95% CI: 0.99–0.99; p < .001) and length of index hospitalization (HR = 1.02; 95% CI: 1.02–1.02; p < .001) were also associated with risk of seizure claim after hospital discharge. Sex, CCI, number of all-cause hospitalizations during baseline, and stroke treatment complexity were not significantly associated with risk of seizure claims after index hospitalization.

3.4 | Mortality following stroke

During follow-up, mortality rate (deaths/1000 patient-years) was 187.0 in patients with seizure claim (Cohort A, N = 6054), and 204.6 in patients without (Cohort B, N = 47 829). The highest mortality rate was observed in patients with a seizure claim during index stroke hospitalization (Cohort A-3, N = 2130; 318.9 deaths/1000 patient-years). In patients with index hospitalization in 2011, mortality rate was 168.6 in patients with seizure claims (Cohort A-1) and 185.5 in patients without (Cohort B-1).

Multivariate Cox-regression analysis in all patients with stroke (N = 53 883) showed that patients with hemorrhagic stroke had a significantly higher risk of early death after index hospitalization (HR = 1.72; 95% CI: 1.66–1.78; p < .001) compared with those who had cerebral infarction (Table 3). Stroke not specified as hemorrhage or infarction was also associated with increased risk of mortality compared with cerebral infarction (HR = 1.26; 95% CI: 1.19–1.34; p < .001). Patients with a seizure claim during index hospitalization had an increased risk of death after hospital discharge in comparison with patients who had no seizure claims during index hospitalization (HR = 1.78; 95% CI: 1.68–1.89; p < .001). Age (HR = 1.07, 95% CI: 1.07–1.07), CCI at baseline (HR = 1.07, 95% CI: 1.06–1.07), length of index hospitalization (HR = 0.99, 95% CI: 0.99–0.99), and number of all-cause hospitalizations (HR = 1.09, 95% CI: 1.08–1.10) during baseline were also associated with risk of death (p < .001 for all). Female sex was associated with decreased risk of death (HR = 0.97, 95% CI: 0.95–1.00; p = .047). Stroke treatment complexity was not significantly associated with risk of death.

3.5 | Neuropsychiatric comorbidities

The most common neuropsychiatric comorbidities during the 12-month baseline period in patients who later had seizure claims (Cohort A), as well as those who did not (Cohort B), were anxiety, dissociative and somatoform disorders, and depression (Table 4).
### TABLE 1 Baseline patient characteristics and characteristics of index stroke hospitalization.

|                  | Cohort A: Patients with seizure claim (N = 6054) | Cohort B: Patients without seizure claim (N = 47,829) | p-value | Cohort A-1: Patients with seizure claim and index hospitalization in 2011 (N = 1450) | Cohort B-1: Patients without seizure claim and index hospitalization in 2011 (N = 10,077) | p-value | Cohort A-2: Patients with at least two seizure claims | Cohort A-3: Patients with seizure claim during index hospitalization (N = 2130) |
|------------------|-----------------------------------------------|-------------------------------------------------------|---------|-----------------------------------------------|-------------------------------------------------------|---------|-----------------------------------------------|-----------------------------------------------|
| Age at index date, years |                                              |                                                        |         |                                              |                                                        |         |                                              |                                              |
| Mean (SD)        | 73.95 (12.89)                                | 76.48 (12.41)                                         | <.001   | 73.83 (12.41)                                | 76.83 (11.87)                                         | <.001   | 72.83 (13.09)                                | 74.69 (13.00)                                |
| Median (range)   | 77 (1–100)                                   | 79 (1–105)                                            | <.001   | 76 (19–98)                                   | 79 (1–104)                                            | <.001   | 76 (1–100)                                   | 78 (1–100)                                   |
| Sex              |                                              |                                                        |         |                                              |                                                        |         |                                              |                                              |
| Female (%)       | 54.18                                        | 56.02                                                 | <.007   | 57.10                                        | 58.08                                                | .480    | 53.14                                        | 53.57                                        |
| Charlson Comorbidity Index |                                              |                                                        |         |                                              |                                                        |         |                                              |                                              |
| Mean (SD)        | 4.09 (3.04)                                  | 4.15 (2.93)                                           | .104    | 4.03 (2.99)                                  | 4.13 (2.87)                                           | .228    | 3.93 (2.98)                                  | 4.13                                         |
| <3 (%)           | 34.77                                        | 33.01                                                 | .007    | 51.52                                        | 52.56                                                 | .364    | 36.43                                        | 35.59                                        |
| 3–5 (%)          | 36.11                                        | 38.30                                                 | .007    | 20.41                                        | 19.80                                                 | .485    | 36.12                                        | 34.18                                        |
| >5 (%)           | 29.12                                        | 28.69                                                 | .007    | 28.07                                        | 27.65                                                 | .485    | 27.45                                        | 30.23                                        |
| Type of stroke at index hospitalization, % of patients |                                              |                                                        |         |                                              |                                                        |         |                                              |                                              |
| Cerebral infarction<sup>a</sup> | 74.30                                        | 82.24                                                 | <.001   | 74.97                                        | 80.83                                                | <.001   | 73.19                                        | 66.06                                        |
| Hemorrhagic<sup>b</sup> | 22.96                                        | 13.68                                                 | <.001   | 20.21                                        | 13.60                                                | <.001   | 24.34                                        | 31.74                                        |
| Unspecified<sup>c</sup> | 2.74                                         | 4.09                                                  | <.001   | 4.83                                         | 5.58                                                 | .241    | 2.47                                         | 2.21                                         |
| Complexity of stroke treatment, % of patients (diagnosis-related groups; B70A = most complex; B70H = least complex) |                                              |                                                        |         |                                              |                                                        |         |                                              |                                              |
| B70A             | 7.88                                         | 2.18                                                  | <.001   | 6.48                                         | 1.94                                                 | <.001   | 7.92                                         | 15.77                                        |
| B70B             | 15.79                                        | 17.93                                                 | <.001   | 16.00                                        | 16.73                                                | .485    | 16.47                                        | 7.65                                         |
| B70C             | 7.50                                         | 6.14                                                  | <.001   | 6.48                                         | 4.29                                                 | <.001   | 7.56                                         | 10.52                                        |
| B70D             | 8.28                                         | 12.75                                                 | <.001   | 9.59                                         | 10.96                                                | .116    | 8.28                                         | 3.94                                         |
| B70E             | 9.60                                         | 5.73                                                  | <.001   | 9.31                                         | 6.16                                                 | <.001   | 9.43                                         | 14.84                                        |
| B70F             | 20.94                                        | 32.62                                                 | <.001   | 26.00                                        | 38.29                                                | <.001   | 20.01                                        | 11.69                                        |
| B70G (death <4 days after admission) | 0.23                                         | 0.68                                                  | <.001   | 0.21                                         | 0.63                                                 | .059    | 0                                            | 0.66                                         |
| B70H (death <4 days after admission) | 0.33                                         | 1.77                                                  | <.001   | 0.34                                         | 2.06                                                 | <.001   | 0                                            | 0.94                                         |
| DRG code other than B70 | 29.45                                        | 20.20                                                 | <.001   | 25.59                                        | 18.95                                                | <.001   | 30.33                                        | 33.99                                        |
| Length of stay, days |                                              |                                                        |         |                                              |                                                        |         |                                              |                                              |
| Mean (SD)        | 16.11 (14.17)                                | 11.48 (9.40)                                          | <.001   | 15.52 (14.34)                                | 11.66 (8.97)                                          | <.001   | 16.68 (14.27)                                | 16.78                                        |
| Median (range)   | 12 (1–195)                                   | 9 (1–217)                                             | <.001   | 12 (1–164)                                   | 10 (1–123)                                            | <.001   | 13 (1–195)                                   | 13 (1–195)                                   |

<sup>a</sup>ICD-10 I63.  
<sup>b</sup>ICD-10 I60.- /I61.- /I62.  
<sup>c</sup>ICD-10 I64.-
During 12-months of follow-up, depression \((p < .001)\) was more common in patients with than without seizure claims (Table 4).

### 3.6 | Outpatient AED treatment

In the first year of follow-up, 4465 of 6054 (73.75%) patients with a seizure claim (Cohort A) received AED treatment; no AED treatment was recorded in the remaining 1589 (26.25%) patients of whom 1052 (66.21%) died during follow-up. The most commonly prescribed AEDs (prescribed in ≥5% of patients) were levetiracetam, valproic acid, gabapentin, lamotrigine, and pregabalin (Figure 2A). Most patients (73.73% [3292 of 4465]) who received AED treatment in the first year of follow-up remained on first-line therapy. Of 1173 patients with a second-line treatment, 711 (60.61%) remained on that therapy. In the second year of follow-up, 3024 (64.57%) surviving patients (\(N = 4683\); patients who did not die before the start of the second observational year) received AED treatment (Figure 2B); 2292 (48.94%) patients had more than two AED prescriptions (Figure 2C). In patients with at least one seizure claim during index hospitalization (Cohort A-3), 1278 of 2130 (60.00%) received AED treatment in the first year of follow-up. In the second year of follow-up, 612 (49.80%) patients surviving into the second observational year (\(N = 1229\)) had more than two AED prescriptions.

### 4 | DISCUSSION

The results of this large retrospective claims database analysis with a median follow-up of nearly 2.5 years showed that a substantial proportion of patients (11.24%) with acute stroke and no previous epilepsy diagnosis had at least one seizure claim during/after stroke hospitalization. A seizure claim does not necessarily indicate an epilepsy diagnosis, as patients may have had an acute symptomatic

| TABLE 2 Multivariate Cox-regression analysis of seizure claim after index stroke hospitalization: all patients with acute stroke (\(N = 53\) 883) | Variables | Hazard ratio (95% CI) | p-value |
|---|---|---|---|
| Age at stroke\(^a\) | 0.99 (0.99–0.99) | <.001 |
| Sex\(^b\) | Female 1.06 (1.00–1.12) | .058 |
| Type of stroke\(^c\) | Hemorrhage\(^d\) (ICD–10 Code: ICD–10 I60.-/I61.-/I62.-) 1.13 (1.06–1.21) | <.001 |
| | Not specified as hemorrhage or infarction (ICD–10 code: I64.-) 0.88 (0.75–1.04) | .146 |
| Length of index hospitalization\(^e\) | 1.02 (1.02–1.02) | <.001 |
| Seizure claim during index hospitalization\(^f\) | 6.97 (6.53–7.43) | <.001 |

Patients were censored at death or end of observation. Number of patients with at least one seizure claim after index hospitalization: 5228. CCI, number of all-cause hospitalizations during baseline, and complexity of stroke treatment (based on DRG codes) did not show significant impact on time to first seizure claim after index hospitalization and are therefore not included in the table. Abbreviations: CCI, Charlson Comorbidity Index; ICD-10, International classification of diseases, 10th revision.

\(^a\) Analyzed as a continuous variable.

\(^b\) Reference: male.

\(^c\) Reference: cerebral infarction (ICD-10 code: I63.-).

\(^d\) Subarachnoid, intracerebral or nontraumatic intracranial.

\(^e\) Reference: no seizure claim during index hospitalization (patients may have had a seizure claim after index hospitalization).

| TABLE 3 Multivariate Cox-regression analysis of death after index stroke hospitalization: all patients with acute stroke (\(N = 53\) 883) | Variables | Hazard ratio (95% CI) | p-value |
|---|---|---|---|
| Age at stroke\(^a\) | 1.07 (1.07–1.07) | <.001 |
| Sex\(^b\) | Female 0.97 (0.95–1.00) | .047 |
| Type of stroke\(^c\) | Hemorrhage\(^d\) (ICD–10 Code: ICD–10 I60.-/I61.-/I62.-) 1.72 (1.66–1.78) | <.001 |
| | Not specified as hemorrhage or infarction (ICD–10 code: I64.-) 1.26 (1.19–1.34) | <.001 |
| CCI at baseline\(^e\) | 1.07 (1.06–1.07) | <.001 |
| Length of index hospitalization\(^f\) | 0.99 (0.99–0.99) | <.001 |
| Seizure claim during index hospitalization (included as a time-dependent variable)\(^g\) | 1.78 (1.68–1.89) | <.001 |
| Number of all-cause hospitalizations during baseline\(^h\) | 1.09 (1.08–1.10) | <.001 |

Patients were censored at end of observation. Number of patient deaths: 24 257. Complexity of stroke treatment (based on DRG codes) did not show significant impact on time to first seizure claim after index hospitalization and are therefore not included in the table. CCI, Charlson Comorbidity Index; ICD-10, International classification of diseases, 10th revision.

\(^a\) Analyzed as a continuous variable.

\(^b\) Reference: male.

\(^c\) Reference: cerebral infarction (ICD-10 code: I63.-).

\(^d\) Subarachnoid, intracerebral or nontraumatic intracranial.

\(^e\) Reference: no seizure claim during index hospitalization (patients may have had a seizure claim after index hospitalization).
seizure following stroke without developing epilepsy. Of 6054 patients with a seizure claim (Cohort A), 69.01% had an additional seizure claim (Cohort A-2), indicating that these patients had developed epilepsy. The incidence of epilepsy following hospitalization for stroke (defined as patients with ≥2 seizure claims [during/after index hospitalization], or ≥1 seizure claim after index hospitalization) was 94.49 cases/1000 patient-years within 1 year and 46.97 cases/1000 patient-years over the total follow-up period.

A similar analysis of administrative claims using data from the United States found that 8–15% of patients with stroke may develop PSE, depending on the type of stroke. Analyses based on clinical data have shown comparable results. A prospective multicenter study in 1897 patients with stroke (and no previous epilepsy) found that 8.9% of patients had at least one poststroke seizure (either acute symptomatic or unprovoked). The incidence of poststroke seizures was likely lower because of a shorter mean follow-up time (9 months vs approximately 31 months in the current study). In a study of 421 patients with a mean observation period of 30 months, incidence of seizures after a cerebrovascular event (>80% stroke) was 11.6%. In a prospective German study of 1020 patients with stroke, 8.2% developed PSE within 2 years. A retrospective study of 240 patients with a mean follow-up time of 868 days (median: 1062 days) found that 13 patients (5.4%) developed PSE (11 were diagnosed with epilepsy and two had patient records indicative of epilepsy). Incidence of PSE was estimated to be 23 cases/1000 patient-years. However, only patients with ischemic stroke were included in that study, which may have contributed to the lower incidence of epilepsy.

Our results showed that hemorrhagic stroke at index was more common in patients with a subsequent seizure claim than in patients without. Furthermore, Cox regression analysis showed that patients with hemorrhagic stroke and seizure claim during index hospitalization were at higher risk of seizure claim after index hospitalization discharge. This is in line with previous studies. Prospective studies in 1200 participants with ischemic stroke in Switzerland.

### TABLE 4 Neuropsychiatric comorbidities at baseline and follow-up: all patients with acute stroke

| Comorbidity, n(%) | 12 months baseline | 12 months follow-up |
|-------------------|---------------------|---------------------|
|                   | Cohort A: Patients with seizure claim (N = 6054) | Cohort B: Patients without seizure claim (N = 47 829) | Cohort A: Patients with seizure claim (N = 6054) | Cohort B: Patients without seizure claim (N = 47 829) |
| Anxiety, dissociative, and somatoform disorders | 1098 (18.14) | 8186 (17.12) | 1198 (19.79) | 8708 (18.21) |
| Depression | 1044 (17.24) | 7731 (16.16) | 1877 (31.00) | 10 893 (22.77) |
| Personality disorder | 67 (1.11) | 344 (0.72) | 67 (1.11) | 344 (0.72) |
| Schizophrenia | 60 (0.99) | 379 (0.79) | 77 (1.27) | 449 (0.94) |
| Psychoses | 58 (0.96) | 296 (0.62) | 90 (1.49) | 346 (0.72) |
| Bipolar disorder | 40 (0.66) | 214 (0.45) | 53 (0.88) | 240 (0.50) |
| Delusional disorders | 29 (0.48) | 189 (0.40) | 39 (0.64) | 212 (0.44) |
| Adjustment / disturbance of conduct disorder | 28 (0.46) | 205 (0.43) | 39 (0.64) | 235 (0.49) |
| Other psychiatric disorder | 6 (0.10) | 52 (0.11) | 15 (0.25) | 89 (0.19) |
3028 (50.02)
Valproic acid  445 (7.35)
Gabapentin  429 (7.09)
Pregabalin  423 (6.99)
Carbamazepine  292 (4.82)
Lacosamide  163 (2.69)
Zonisamide  154 (2.54)
Oxcarbazepine  120 (1.98)
Topiramate  89 (1.47)
Clonazepam  84 (1.39)
≥1 AED  1589 (26.25)
No AEDs  4465 (73.75)

(A) Levetiracetam

1994 (42.58)
Valproic acid  448 (9.57)
Gabapentin  262 (5.59)
Lamotrigine  261 (5.57)
Pregabalin  226 (4.83)
Carbamazepine  162 (3.46)
Lacosamide  81 (1.73)
Zonisamide  81 (1.73)
Oxcarbazepine  59 (1.26)
Topiramate  42 (0.90)
Clonazepam  32 (0.68)
≥1 AED  1659 (35.43)
No AEDs  3024 (64.57)

(B) Levetiracetam

351 (7.50)
Valproic acid  381 (8.14)
Gabapentin  2292 (48.94)
Lamotrigine  2430 (51.89)
Pregabalin  353 (7.54)
Carbamazepine  241 (5.15)
Lacosamide  241 (5.15)
Zonisamide  241 (5.15)
Oxcarbazepine  241 (5.15)
Topiramate  241 (5.15)
Clonazepam  241 (5.15)
≥1 AED  241 (5.15)
No AEDs  241 (5.15)

(C) Number of prescriptions and AED use in patients with acute stroke and seizure claim (Cohort A, N = 6,054).

Our study has several limitations. All data were based on inpatient and outpatient claims from an administrative claims database;
no clinical data were available for confirmation of epilepsy diagnoses. As mentioned previously, the exact dates when seizures occurred were unknown. We were, therefore, unable to confirm whether patients had acute symptomatic seizures (within 7 days of stroke) or unprovoked seizures (more than 7 days after stroke). We analyzed ICD-10 G40.- claims only. It is possible that a small number of relevant claims were made using the ICD-10 R56.8 code, though ICD-10 G40.- would generally be used for acute symptomatic or unprovoked seizures in Germany. Furthermore, clinical characteristics that may contribute to risk of seizures, such as stroke severity, could not be assessed. Finally, these data were collected from a German database, and may not be generalizable to other countries. Despite these limitations, this study provides long-term data for a large number of patients with stroke and seizure claims, with a substantial number of patients followed up for at least 60 months.

Overall, our results support previous findings that PSE occurs in a substantial proportion of patients with stroke. Hemorrhagic stroke and seizure claim during index hospitalization were risk factors for seizure claims after hospital discharge. In line with guideline recommendations, most patients with seizure claims were treated with AEDs, despite a lack of evidence from clinical trials in this patient population.

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CONFLICT OF INTEREST
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DATA AVAILABILITY STATEMENT
Data from noninterventional studies are outside of UCB Pharma’s data sharing policy and are unavailable for sharing.

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**SUPPORTING INFORMATION**

Additional supporting information may be found online in the Supporting Information section.