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Research paper

Healthcare resource burden of newly diagnosed epilepsy in the US low-income elderly population

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ABSTRACT

Objective: To assess the incremental and relative healthcare resource burden of new-onset epilepsy among the concurrently old and medically indigent.
Design: A retrospective cohort study employing Arizona Medicaid claims data years from 2008 through 2010.
Setting: The elderly poor; dually eligible beneficiaries.
Subjects: To qualify as a patient with newly diagnosed epilepsy, patients were required to (1) be at least 65 years of age; (2) be continuously enrolled in Arizona Medicaid for at least 12 months; (3) have seizure-related healthcare claims; (4) no claims with a diagnosis code of 345.x1; and (5) have a one-year clean period without evidence of epilepsy or seizure disorder.
Measurements: The outcome variables assessed included total monthly healthcare, inpatient, outpatient, and prescription costs to Arizona Medicaid, incidence rate of inpatient stay, and incidence rate of physician visits.
Results: A total of 472 newly diagnosed patients (15% age $\geq$ 85, 64% female) and 60,256 controls (22% age $\geq$ 85, 65% female) were identified for this analysis. Matched cases had 2.78, 3.82, 2.70, 1.55, 2.72, and 1.28 times greater monthly total healthcare costs ($P < 0.001$), inpatient costs ($P < 0.001$), outpatient costs ($P < 0.001$), prescription drug costs ($P = 0.149$), inpatient visits ($P < 0.001$), and physician visits ($P = 0.377$) compared with their counterpart. Incremental monthly total healthcare costs in patients with newly diagnosed epilepsy were on average 2066 (SE = 432) US dollars.
Conclusions: The elderly poor with newly diagnosed epilepsy in the US had significantly greater healthcare resource use compared with those without epilepsy.
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1. Introduction

Epilepsy remains a substantial economic and patient burden both in the United States (US) and worldwide, particularly in the elderly population. The average total cost of epilepsy in Europe was approximately €15.5 billion [1]. In the US, Yoon et al. found that a patient with epilepsy on average had 4523 USD (2004 value) greater healthcare cost as compared to those without epilepsy [2]. Indirect costs may range from 15%, up to approximately 60% of the total healthcare costs of epilepsy when particular categories such as the patient's loss of his/her driver's license and retiring early were considered [3].

Patients with epilepsy also suffer from impaired quality of life. Baker et al. showed that patients with no seizure episodes had substantially higher scores in the Short Form 36 Health Survey (SF-36) compared with both patients who had less than one seizure episode per month and one or more episode per month [4]. Additionally, there was an inverse relationship between seizure frequency and quality of life [4,5]. In addition to quality of life, patients may have greater risk of falls or fractures due to seizure occurrence or adverse events of antiepileptic drugs (AED) and mortality [6].

Recognizing the economic burden of epilepsy can lead to further proactive and preventive approaches to lessen these burdens. Previous research on quantifying the excessive burden of

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epilepsy had focused on the prevalence of epilepsy among general US or Canadian population, where the disease burden in vulnerable populations does not receive sufficient attention [2,7]. For instance, Reid et al. examined the burden of the general Canadian population with epilepsy and revealed that almost 18% of persons with epilepsy reported being hospitalized overnight over the past 12 months, compared with 8.0% in the general population ($P < 0.05$). Additionally, epileptic patients had a higher proportion being admitted to hospitals due to injury compared with the general population (14.3% vs. 7.8%, $P < 0.05$). Moreover, patients with newly diagnosed epilepsy in general have greater mortality rates and thus greater disease severity compared with prevalent cases [8]. As such, it is possible that the burden of epilepsy may be more apparent among incident as compared to prevalent cases. Thus, this study purported to quantify the excessive monthly healthcare utilization pertaining to newly diagnosed epilepsy among a sample of low-income elderly patients with epilepsy in the US. Quantification of such burden may serve as critical data for healthcare policy makers to understand the relative impact of diseases on healthcare budgets.

2. Methods

Medicaid claims data from the State of Arizona (including hospitalization, outpatient visits, physician office visits, long-term care visits, and prescription claims) for the years from 2008 through 2010 were obtained from the Arizona Health Care Cost Containment System (AHCCCS) for analysis in this study. Data from the year 2008 were used to determine case eligibility and patient comorbidity and was not used for outcome assessment; years 2009 and 2010 were used to assess outcome measures. Medicare and Medicaid are the only health payment systems in the US that are available in every state. People aged 65 or older, or those who aged less than 65 but have eligible disabilities or end-stage renal disease are eligible for Medicare. In 2012, more than 80% of Medicare beneficiaries are composed of the elderly, and at least 95% of the elderly are covered by Medicare [9]. Medicaid programs, such as the Arizona Medicaid administered by AHCCCS, are predominantly established for providing low-premium health insurance for the low-income population [10]. To be eligible to enroll in the Arizona Medicaid, beneficiaries in general are required to have an annual income lower than pre-specified upper income limits (usually between 133–150% US federal poverty line [FPL] [2009 FPL: $22 K {in 2009 USD} for a 4-person household]).

To be eligible for this study and be classified as an incident case, the following criteria must have been met:

- one or more healthcare claim (including claims associated with inpatient, outpatient, long-term care, or physician office visits) with a diagnosis code of 345.xx (indicating epilepsy); or two or more healthcare claims with a diagnosis code of 780.3x (indicating seizure) that were at least 30 days but no more than one year apart [11,12];
- age greater than or equal to 64 years of age as of 1 January 2008;
- continuous enrollment for at least 12 months between 2008 and 2009;
- continuous enrollment of 12 full months prior to the index event (i.e., the first healthcare claim with an epilepsy or seizure diagnosis code in 2009);
- have a 12-month period immediately preceding the index event in the absence of healthcare claims related to epilepsy or seizure;
- the index event of cases must occur prior to 1 January 2010;
- first seizure or epilepsy-related healthcare claim cannot have a diagnosis code of 345.x1 (intractable epilepsy) [11].

Controls must fulfill all of the following eligibility criteria:

- no diagnosis codes for epilepsy or convulsion between 2008 and 2010;
- continuously enrolled in AHCCCS for at least 12 months between 2008 and 2009;
- at least 64 years of age as of 1 January 2008.

Outcomes of interest included costs (total monthly healthcare costs to AHCCCS, total monthly inpatient costs to AHCCCS, total monthly outpatient costs to AHCCCS, and total monthly prescription costs to AHCCCS) and utilization (incidence rate of inpatient visits, and incidence rate of physician visits) aspects. Cost data were presented as 2012 US dollars [13]. Monthly healthcare-related costs were calculated across years 2009 and 2010 divided by the total number of days enrolled in AHCCCS, followed by multiplying 30. Incidence rate pertaining to inpatient visits were derived from total length of inpatient stay accounting for length of time enrolled in AHCCCS. Incidence rate of physician visits was derived from summing up the single-day number of visits to any of the following places of service: physician office, outpatient hospital, independent clinic, federally qualified health center, comprehensive outpatient rehabilitation facility, public health clinic, and rural health clinic, accounting for length of time enrolled in AHCCCS. Computation of the outcome measures for cases were only limited to those that patients incurred on and after the index date.

Propensity score matching (PSM) was applied to remove selection bias arising from covariate imbalance between cases and controls [14]. Initially, a logistic regression model using the log odds of the probability of contracting epilepsy as the outcome and a set of independent variables were constructed to estimate propensity scores for cases and controls. The set of independent variables is listed as follows: age, gender, race, Charlson comorbidity index (CCI) [15], marital status, and potential disease-based risk factors of epilepsy (including anoxic brain injury, stroke, atherosclerosis, brain tumor, Alzheimer's disease, Parkinson's disease, dementia, hypertension, and sleep apnea). The controls were further matched on propensity scores using a 1:1 ratio to cases using the nearest neighbor matching within a caliper approach based on propensity scores to constitute the matched case and control group. A caliper of 0.25 standard deviation of the logit transformation of propensity scores was applied [14]. The distribution of propensity scores between cases and controls was examined using Kolmogorov–Smirnov equality of distributions test [16]. Ideally, the distributions should be fairly identical to ensure proper matching. Additionally, Pearson's Chi^2 test for categorical variables and non-parametric trend test for ordinal variables were used to determine whether the covariates are balanced between matched cases and controls. Following the matching, univariate clustered generalized linear models (GLM) using Poisson family and log link were constructed using each case and its corresponding control as the cluster unit to estimate the relative burden of epilepsy (expressed as risk ratios). The modified Park test was used to determine the appropriate family: all costs and utilization outcomes showed a proportional relationship between the mean and variance, indicating that Poisson was the appropriate family to use [17]. The use of log link can effectively prevent retransformation bias, which could be easily introduced when conducting log or other types of transformation. Differential length of time enrolling in AHCCCS was incorporated in the Poisson GLM models. Post-matching paired *t*-tests were applied to estimate the incremental costs of epilepsy (expressed in differences in absolute value). $P < 0.05$ was considered statistically significant. This study has been approved by the University of Arizona Institutional Review Board.

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