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Nationwide trends in medical expenditures among adults with epilepsy: 2003–2014

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ABSTRACT

Objective: Healthcare expenditure among adults with epilepsy is high. There is a paucity of published data on trends in the nationwide economic impact of epilepsy. This study examines trends in healthcare expenditures and components in U.S. adults with epilepsy between 2003 and 2014.

Methods: We analyzed 12 years of data representing a weighted sample of 1,942,413 U.S. adults aged ≥ 18 years with epilepsy using Medical Expenditure Panel Survey Household Component (MEPS-HC), 2003–2014 data. We used a novel two-part model (adjusting for demographic, comorbidity, and time) to estimate the incremental healthcare expenditures by epilepsy status. Pre and post Affordable Care Act era costs were compared.

Results: Overall unadjusted annual mean medical expenditures for patients with epilepsy was $15,324. Individuals with epilepsy had nearly three times higher overall unadjusted mean expenditure than those without epilepsy ($15,324, 95%CI: 2778–17,871 vs. $5824, 95%CI: 5722–5926). The unadjusted annual mean medical expenditure decreased over time from $17,994 (95% CI $10,754–$25,234) in 2003/2006 to $13,848 (95% CI: $11,371–$16,324) in 2011/2014; a trend driven primarily by a decrease in inpatient expenditures from $5613 to $4113. Having a diagnosis of epilepsy increased health expenditure by $8598 which was 2.5 to 6 times greater than the equivalent incremental health expenditures for other selected comorbidities. Healthcare expenditure among adults with epilepsy was $4083 lower in the post- Affordable Care Act.

Conclusion: Over the last decade, individuals with epilepsy incurred significantly higher medical expenditures than those without epilepsy, but overall healthcare expenditure decreased over time due to a decrease in inpatient expenditures.

1. Introduction

Epilepsy is a global epidemic affecting nearly 50 million people worldwide [1]. It is the fourth most common neurological disorders after migraine, stroke, and Alzheimer disease affecting 2.2 million people in the United States (US) [2]. People with epilepsy are at greater risk of death from epilepsy and epilepsy related complications [3,4]. The mortality and morbidity burden associated with epilepsy translate into a substantial financial burden to patients, families, communities, and the nation. In the US, total cost estimates for epilepsy (both direct and indirect in 2004 U.S. dollar) ranged from $9.6 billion to $12.5 billion per year. Four recent studies using claims from large populations in the United States reported annual per person epilepsy specific cost estimates ranging from $8412 to $11,354 [5].

Studies examining healthcare expenditures in people with epilepsy are available [5,6]. Extant studies have been limited to selected population, single aspect of care such as hemispherectomy in children with medically refractory epilepsy or uncontrolled focal epilepsy [7,8,9]. Ideally, to better inform epilepsy policy makers and for a greater impact on health care system refinement, studies on epilepsy-costs trends should include multiple cost components such as in-hospital, office-based, medications-related, outpatient, emergency room, and home health costs. Comprehensive and updated assessment of trends in medical expenditures among people with epilepsy is highly needed in view of recent pharmacological progresses, widespread utilization of novel treatment approaches such as vagal nerve stimulation or responsive neuro stimulation, increased number of epilepsy services and specialists, as well as recent changes in nationwide healthcare policies [10].

We are not aware of any study that has comprehensively quantified the change in health care expenditures over time among people with epilepsy in the US, especially inclusive of an era that covered the

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introduction of the Affordable Care Act, which was signed into law on March 23, 2010. As such, we conducted an analysis of trends in healthcare expenditures in US adults with epilepsy spanning a period from 2003 through 2014 using appropriate cost estimation methods and recent data from the largest nationally representative survey of the medical costs in the United States. The cost methodology in this study accommodates zero observations and skewed positive expenditures; and the calculation of regression based incremental expenditures.

2. Methods

2.1. Data source and sample

The retrospective database analysis of 2003–2014 Medical Expenditure Panel Survey Household Component (MEPS-HC) was used to estimate the cost of epilepsy among adults of US population (aged ≥ 18 years). The MEPS has been conducted annually since 1996 and is available as a public used file with personal identifiers removed; the publicly available MEPS-HC survey was used in the current study. The MEPS-HC is a U.S. large scale nationally representative survey maintained and cosponsored by the Agency for Healthcare Research and Quality (AHRQ) [11]

We analyzed the responses of 2450 (weighted sample of 1,942,413) US adults (aged 18 years or older) with Clinical Classification Codes (CCC) for epilepsy using Medical Expenditure Panel Survey Household Component (MEPS-HC), 2003–2014 data. MEPS is a survey of a nationally representative U.S. civilian non-institutionalized part of the US population [11,12]. The AHRQ validates MEPS as a self-reported instrument by administering many quality assurance procedures like validation on interviewer's work and also comparing MEPS numbers with other data source numbers like the Census Bureau and National Health Interview Survey (NHIS). MEPS collects detailed information at the individual level and family level related to participants' use of medical care and their medical spending, as well as information on demographics, socioeconomics, and health conditions. Medical expenditures are defined as the payments that health care providers receive from all payers (including insurance providers, survey respondents, and other sources) as well as out of pocket expenditures by individuals [13]. The medical costs used in this study were inflated to the recent estimate of 2016-dollar value using the consumer's price index obtained from the Bureau of Labor Statistics (BLS) [14].

Information on the MEPS-HC is collected by self-report, and the Medical Provider Component (MPC) requests data on medical and financial characteristics from hospitals, physicians, home health care providers, and pharmacies in order to validate and supplement information received from the MEPS-HC respondents. Diagnoses coded according to ICD-9-CM (International Classification of Disease, Ninth Revision, Clinical Modification) are also collected as part of the MPC 15. Individuals with epilepsy were extracted from MEPS-HC medical condition files using CCC at person level. We merged data from the HC survey of the medical condition files and full-year consolidated files using the unique person identifier (DUPERSID) on a one-to-one match [12]. We pooled 12-year data to ensure sufficient sample size of individuals with epilepsy and increase precision of our estimates. The medical conditions and procedures reported by the MEPS-HC related to disease condition was recorded by an interviewer as verbatim text and then converted by professional coders to ICD-9-CM codes. The error rate for any coder did not exceed 2.5% on verification. To protect the confidentiality of respondents, fully specified ICD-9-CM codes were collapsed to three digits [12]. Our study accounts for the sampling weights, clustering and stratification design to estimate the nationally representative aggregate and incremental healthcare expenditure for the US population [13].

2.2. Measures

2.2.1. Variables of interest

The dependent variable in this study was total annual healthcare expenditure, defined as a sum of office-based medical provider expenditure, hospital outpatient expenditure, emergency room expenditure, inpatient hospital (including zero night stays) expenditure, prescription medicine expenditure, home health care expenditure, dental expenditure, and other medical expenses [13]. We used CCC defined in MEPS to represent disease condition. The CCC was generated using Clinical Classification Software and it aggregates ICD-9-CM and V-codes into clinically meaningful mutually exclusive categories, most of which are clinically homogeneous [12,15]. The primary independent variable was epilepsy. Diagnosis-defined 'epilepsy' was identified by Clinical Classification Codes (CCC) of 83 recorded in the medical condition files [12,16]. MEPS data are cross-sectional, as such, we did not have the same observation of epilepsy and control groups in the three points in time.

2.2.2. Covariates

Adjusted analyses used covariates collected through self-report. Binary indicators of co-morbidities were based on a positive response to a question "Have you ever been diagnosed with diabetes, hypertension, stroke, emphysema, joint pain, arthritis and asthma?" Cardio Vascular Disease (CVD) indicates a positive response to a question "Have you ever been diagnosed with coronary heart disease or angina or myocardial infarction or other heart diseases?" Race/ethnic groups are categorized in to four: Non-Hispanic White (NHW), Non-Hispanic Black (NHB), Hispanic and Others. Education was categorized as: less than high school (≤ grade 11), high school (grade 12) and college or more (grade ≥ 13).

Marital status was coded into three groups: married, non-married (Widowed/Divorced/separated) and never married. Gender was coded as male vs female and age was coded into three age groups: 18–44, 45–64 and ≥ 65 years. Census region was coded as: Northeast, Midwest, South and West. Health insurance was coded into 3 categories: private, public only, and uninsured at all time in the year. The income level was defined as a percentage of the poverty level and grouped in to four categories: poor (< 125%), low income (125% to < 200%), middle income (200% to < 400%) and high income (≥ 400%). Calendar year was grouped into 2003/06, 2007/10 and 2011/14 for the pooled data.

2.2.3. Analyses

The demographic characteristics of patients are presented by epilepsy status, as percentages for categorical variables, with differences tested using chi square (χ^2) tests. In survey design, we estimated the unadjusted mean direct healthcare expenditures for individuals by epilepsy status. A two-part model was used to estimate the adjusted incremental medical spending. A probit model for the probability of observing a zero versus positive medical expenditure, and then a generalized linear model (GLM) to estimate the adjusted association of total medical expenditures conditional on a positive medical expenditure was used [17,18]. Two-part models can accommodate situations with excess zeros, such as expenditure data, non-normal error-terms, and calculation of marginal effects and standard errors [14]. The use of GLM in the second part of the model has an advantage over log Ordinary Least Squares (OLS) since it relaxes the normality and homoscedasticity assumptions and avoids bias associated with re-transforming to the raw scale [18]. The Park test, used as a diagnostic test to examine the model fit, verified the use of a gamma distribution with a log link as the best–fitting GLM for consistent estimation of coefficients and marginal effects of medical expenditures [19]. We also used 'margins' post estimation command following the adjusted GLM to