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A Systematic Literature Review of Health Disparities Among Rural People with Epilepsy (RPWE) in the United States and Canada

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Abstract

Background: Epilepsy is a leading cause of global disease burden, with people with epilepsy (PWE) experiencing adverse health outcomes related to the psychiatric comorbidities and socioeconomic consequences of the disorder. Rural populations are more likely to be impoverished or uninsured, which could impact health outcomes for rural-dwelling PWE (RPWE).

Aims: This systematic literature review identified original research studying health disparities and outcomes among RPWE in the United States and Canada to (1) characterize the disparities faced by RPWE and (2) elucidate the effects of these disparities upon clinical outcomes.

Methods: We performed a systematic search of six electronic databases: Pubmed, Cochrane, PsychInfo, Web of Science, Scopus and Ovid. Articles considered were original research reports conducted in Canada or the United States before August 2020. A modified Newcastle Ottawa Scale was used to assess the quality of the included studies.

Results: Our search returned 2093 articles that examined the health disparities of RPWE, of which six met criteria for this review. Outcome measures of health disparity included in these papers were mortality (2; 33%), use of health resources (2; 33%) and epilepsy prevalence (2; 33%). Only one paper (16%) concluded that RPWE experienced worse health outcomes relative to urban-dwelling PWE, while 5 (84%) found no difference.

Conclusion: Our study did not find sufficient evidence that RPWE in the US and Canada experience significant health disparities compared to similar urban populations of PWE. More research using prospective studies and datasets allowing better characterization of rurality is required.

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Keywords

epilepsy; rural; under-served; inequities; mortality

1. Introduction

Epilepsy is the second-most burdensome neurologic disorder worldwide in disability adjusted-life years[1] and affects an estimated 3.4 million people, or 1.2% of the U.S. population.[2] One 2004 study estimated the economic impact of epilepsy to be approximately $9.5 billion in direct medical care costs in the United States alone.[3] For patients, the financial burden of epilepsy is just one consequence of this chronic condition. One in five people with epilepsy (PWE) have cognitive limitations, and 30–50% will struggle with major depressive disorder. Driving restrictions are placed on those with seizures, and, as such, 45.7% of those with active epilepsy face work limitations or are unable to work.[4] Furthermore, these restrictions may be exacerbated by other factors, including enhanced stigma, lower socioeconomic status, and poor quality of life.[5]

The U.S. Bureau of the Census defines “rural” as all population, housing, and territory not included within urbanized areas or urban clusters.[6] By this definition, 19.3% of the U.S. population lives in a rural area. As a group, rural populations possess significant health disparities compared to urban populations.[7–9] Rural communities have more uninsured residents under 65, lower median household incomes, higher percentage of children living in poverty and higher rates of all-cause mortality.[7] Rural-dwelling individuals experience increased travel time, distance and, consequently, perceived difficulty in obtaining care.[10,11] At the patient-level, rural-dwellers have lower educational levels, earn less income and are more likely to be unemployed.[12]

Elucidating the impact of health disparities on rural-dwelling people with epilepsy (RPWE) is warranted given epilepsy’s prevalence and cost to society, as well as the mounting evidence regarding a rural-urban healthcare gap. Insights into these discrepancies can help inform policy and practice interventions aiming to improve outcomes for RPWE. In this systematic literature review, we assess and describe the original research on health disparities in RPWE in the United States and Canada by analyzing population definitions, study designs and conclusions on health outcomes. We expect that the results of this analysis will help identify gaps in the literature and provide guidance for further study. We hypothesized that RPWE in the United States and Canada experienced more health disparities compared to urban-dwelling PWE.

2. Methods

2.1 Search strategy:

In collaboration with a university research librarian (AS), six electronic databases (Pubmed, Cochrane, PsychInfo, Web of Science, Scopus and Ovid) were searched for original research on the health outcomes of RPWE compared to other groups of PWE. For this study, we used the definition of health disparity by Carter-Pokras and Baquet as, “differences in health

outcomes and their determinants between segments of the population, as defined by social, demographic, environmental, and geographic attributes" to focus discussion on the intended variable of RPWE without a presumption of inherent disadvantage.[13] Search terms of three types were utilized. For disease state, "epilepsy", "seizures" and "convulsions" were used. For rural status, "rural", "under-served" and "farming communities" were used. Finally, for health disparities, "health disparities", "inequities", "care access", "services" and "mortality" were used. These terms were chosen as they incorporated both the health outcomes and the multiple social determinants, including geographic location and socioenvironmental barriers, noted in our definition of health disparities.

2.2 Screening and selection process:

Basic source information, including title and abstracts, were extracted from these articles and uploaded to the Rayyan QCRI software for expeditious review.[14] Included articles were restricted to English-language literature from the United States and Canada to minimize variance in geography, culture or exposures. A cut-off date of August 2020 was employed. Health outcomes considered were prevalence of disease, mortality, medication use, health insurance, healthcare access, etc. Only original research reports were included; therefore, book chapters, review, editorials and case reports were excluded. Figure 1a summarizes the full inclusion and exclusion criteria. To ensure adequate inter-rater reliability, a standardized sample of 60 representative articles were evaluated by three independent reviewers (SMD, KGO, TC) for similar application of inclusions and exclusions prior to formal review. Formal review then commenced wherein each reviewer screened the results from two databases each to blindly and independently determine applicability to our present study. After excluding grossly non-applicable articles (i.e., non-US/Canadian studies, duplicates, other review, etc.), full-length text review was performed on the remaining papers separately by the reviewers. Any discordance between reviewers was resolved by two other authors (EL and MS). A hand-search was then performed of the included papers to identify other applicable studies.

2.3 Data Extraction:

The primary study variables, which were extracted and analyzed, were the definition of rural population and epilepsy, as well as the measures of health disparities and outcomes. Additional study characteristics were also collected, including the study design, sample size, and method of epilepsy diagnosis.

2.4 Quality Analysis:

We performed a quality analysis of the included studies using a modified Newcastle-Ottawa Quality Assessment Scale (NOS)[15] that included three categories: 1) selection of cohort of PWE and ascertainment of exposure (rural status), 2) comparability of the groups and 3) the ascertainment of the outcome of interest (health disparity). Possible scores were between zero and nine, where nine satisfies all criteria from each category.

3. Results

3.1 Study identification and description:

The article-selection process is summarized in Figure 1b. Initial search results included 2093 articles, of which 54 were selected for full-text review. Five articles met our inclusion/exclusion criteria.[16–20] One further article was added during hand-search.[21] Table 1 presents the results of the data extraction from the six papers. All six included articles were observational studies (four cohort studies and two cross-sectional studies) that directly compared rural and urban PWE with respect to different outcomes measures. All papers were published between 2004 and 2016, with the study data collected between 1998 and 2013. All six studies used International Classification of Diseases, Ninth Revision (ICD-9) codes to confirm the diagnosis of epilepsy within their study sample. In terms of geographic distribution, three (50%) of the studies were performed in the United States, while the other three (50%) were performed in Canada. Three (50%) studies had no age restriction and included PWE of all ages, while the other three (50%) were limited to populations of children and adolescents.

3.2 Quality metrics of studies:

The modified NOS is presented in Supplemental Table 2a. The maximum score on our modified NOS is nine points. Points were lost for inadequate sampling of PWE, failing to define “rural” or lacking sufficient comparability between groups. See Supplemental Table 2b for scoring.

3.3 Rural definition:

Though a definition for rural population was noted in four (67%) of the included papers, the method of classification varied considerably among them. In regard to the American studies, Wilson et al. used the Rural Urban Commuting Area (RUCA) codes to define rurality.[16] These codes range from 1 to 10, and incorporate measures of urbanization, population density and commuting to urban areas.[22] In another paper, that same research group utilized the United States’s Office of Management and Budget (OMB) definition that uses the size of the core urban population to designate counties as being Metropolitan (>50,000), Micropolitan (10,000–50,000), or neither.[17] Using the OMB definition of “Metropolitan Statistical Area”, they considered all other counties “rural”.[23]

The Canadian studies also varied in their definition of rural. One study defined rural as rural geographic areas of <10,000 people[20], while Jetté et al. used a complex definition employing both Canadian postal coding and the proprietary rural definition developed by a governmental contractor utilizing geographic informational systems (GIS).[19]

Two studies did not define “rural” areas but instead used a colloquial definition of “rural”. Banta et al. also employed GIS to identify population clusters that drove epilepsy-related emergency room visits. They returned four clusters: three clusters were located in urban areas such as Oakland or Los Angeles, while the fourth cluster was centralized in the rural Inyo-Kern Census-designated place in rural Southeastern California.[18] The least rigorous definition of rural came from an epidemiological paper by Kozyrskyj and Prasad of seizure

prevalence in Manitoba, Canada.[21] They described four regions of Manitoba (the North, Rural South, Brandon and Winnipeg) by prevalence, income quintiles and prescription rates of specific anti-seizure medications.

3.4 Health disparities:

In our sample of articles, health disparity measures between rural and urban PWE can be grouped as follows: utilization of health services (ED visits and "health resource use"; 33%), all-cause mortality (33%) and epilepsy prevalence (33%).

As discussed above, Banta et al. analyzed the spatial distribution of emergency-room visits in California from 2009–2011 to describe the disparities between the three urban clusters compared to the rural cluster in Inyo-Kern. They found that only the urban LA cluster had increased risk of epilepsy ED visits.[18] Jette et al. studied health resource use (HRU) as defined by ER visits, hospitalizations, length of hospital stay and total billings for physician visits in 2001.[19] They found no difference in rural vs. urban HRU.

Two of the highest quality studies according to our NOS were published by Selassie's group at the Medical University of South Carolina which analyzed all-cause mortality in South Carolina. Their first paper, published in 2015, compared children with epilepsy to matched samples with migraine or lower extremity fractures. This study was the only one that showed worse outcomes between urban and rural populations directly: rural children with epilepsy were 29% more likely to die than their urban counterparts.[17] Their second study expanded that scope to look at all ages and found no statistically increased risk of mortality in rural compared to urban patients.[16]

Finally, the remaining two papers were both epidemiological studies of provincial prevalence of epilepsy in children. Both found no differences in epilepsy prevalence between children living in urban and rural settings.[20,21] However, they did observe a higher prevalence of epilepsy in children living in a low socioeconomic status (SES).

4. Discussion and future directions

Area of residence can affect health at the person level (i.e., lack of routine care, lifestyle, behavior) or the environmental level (i.e., health care shortages, access to care, poverty).[24] 65% of rural areas are considered health professional shortage areas.[25] Consequently, people in rural areas have fewer overall visits to a physician and less referrals to specialists.[25–27] Given the significant health disparities of the rural population as a whole, one might expect similar, if not worse, disadvantages when considering a population of PWE. These disparities are likely aggravated by disease-associated disability, preventing attainment of advanced education and long-term employment. Additionally, PWE may be less mobile due to neurodevelopmental comorbidities and often are impacted by driving restrictions. Pharmacoresistant epilepsy requires subspecialist care and treatments such as neurostimulation or epilepsy surgery, which are often only offered at epilepsy centers in urban areas. As noted by Selassie in the Institute of Medicine report on epilepsy[28], in South Carolina, only 22.8% of PWE are treated by epileptologists or neurologists.

The key question examined in this literature review is whether rural status is an independent factor for worsened health disparity in PWE. Selassie et al. studied all hospital and emergency department discharges in South Carolina from 2000–2012 and found that children with epilepsy were more likely to live in urban areas, be insured by Medicare/Medicaid and receive care at level I hospitals.[17] In that sample, children with epilepsy living in rural areas were 29% more likely to die than children with epilepsy living in urban areas. This mortality was thought to be driven by sequelae of the disease itself (34.7%; SUDEP, status epilepticus, etc.). However, interpretation of these results may be limited by the acute nature of the overall population studied (hospital/ED discharges resulting in a relatively high mortality [8.7 per 1000 patient-years vs 2.7–6.9 per 1000 patient-years]), as well as the lack of adjustment for other demographic and clinical covariables such as median income.

Wilson et al. studied all hospital and emergency department discharges in South Carolina from 2000–2014.[16] In this study, they found RPWE have significantly lower unadjusted survival. However, after adjusting for median income of residential zip code, race, sex, age and other demographic and clinical covariables, rural residency was not a significant predictor of mortality. These results are similar to the findings of Schiariti et al. and Kozyrskyj & Prasad, who found that the prevalence of epilepsy in children from British Columbia and Manitoba was inversely correlated with socioeconomic status.[20,21] These findings suggest a causality dilemma: are those in lower socioeconomic strata more likely to develop epilepsy due to a higher rate of infections, birth asphyxia, prematurity, head trauma, etc. or do they reside in lower strata due to the demands associated with care for PWE and limitations of educational/career advancement?

In total, our present study did not find sufficient evidence to confirm or refute our hypothesis that RPWE face or experience significant health disparities when compared to urban populations of PWE. There are several possible explanations for this observation. PWE may relocate to urban centers for better access to care and other resources such as public transportation, in line with social theories of urban drift. Because medical documentation is necessary for these epidemiological studies, a sampling bias may exist by underestimating prevalence or mortality in populations with restricted access to care. Our findings are in agreement with Schiariti et al. and Kozyrskyj & Prasad who suggest that the health disparities of RPWE are driven by the inherently lower SES of PWE in general, rather than where they reside. This assertion is also supported by examination of the overall rural disparity in United States mortality rates. While there is certainly a difference in mortality rates when rural and urban populations are compared, statistical analyses by Long et al. has indicated that the contribution of the rural-urban variable explains less than 2% of the premature mortality variance after controlling for socioeconomic variables.[29] In this regard and with respect to our definition of health disparity, our review adds to the evidence base that rurality as an independent variable does not explain the differences in health outcomes between these two populations, and further research is needed to identify co-variables associated with lower SES. As described previously by Thurman et al., epilepsy is a multi-faceted and highly debilitating disease requiring comprehensive care, both socially and medically, to improve the health disparities of PWE.[30]

There were significant limitations to this study and the conclusions able to be drawn. First, there was a relative dearth of applicable research studies. Despite starting with over two thousand studies, we were only able to identify six meeting our inclusion criteria. Second, even amongst those studies, there was significant heterogeneity amongst the primary outcomes. Often, we were subjected to using secondary outcomes for data analysis. These issues were identified early in our search. To maximize the inclusion of pertinent research studies, we elected not to register our search with Prospero which may have introduced some selection bias to our study. While the definitions of epilepsy were similar between all of our studies (likely a reflection of the emergence of electronic medical records since 2000), the definitions of "rural" varied significantly - and sometimes were not included at all. Finally, because of the relationship of lower socioeconomic status with rural areas, distilling "rurality" as the independent variable proved difficult. Further research using prospective studies or other datasets with SES-matched cohorts are needed to precisely define and explore potential drivers of the health disparities of RPWE relative to their urban counterparts focusing race, gender, disability and distance to major metropolitan areas as independent variables. To facilitate these studies, a standard definition of rurality such as the aforementioned RUCA codes or those laid out by the OMB would be beneficial.

There were several strengths in our analysis that can offset some of the limitations. First, of the included papers, the majority were high quality based upon a modified NOS. There was little variation in the definition of epilepsy, and most papers have been published recently. Most studies examined used larger sample sizes and reached similar conclusions.

5. Conclusions

Our present study did not find sufficient evidence to conclusively confirm or refute the hypothesis that RPWE face or experience worse health disparities than similar urban populations of PWE. Limitations may include an overall paucity of studies, and a causality dilemma among rurality, lower SES, and epilepsy, which makes it difficult to tease out the effects of rural-dwelling alone. This review adds to the growing literature suggesting that the health disparities experienced by PWE may be a function of their lower SES rather than an inherent quality specific to the rural environment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Abbreviations:

PWE	people with epilepsy
RPWE	rural people with epilepsy

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Highlights

- Epilepsy can be burdensome for patients, families, health systems and society
- Health disparities of people with epilepsy can be worsened by living in rural areas
- Demographics and socioeconomic status drive the poor outcomes, not rurality per se
- Prospective studies with standard definitions of rural are needed

a. Inclusion/exclusion Criteria

Inclusion

- Humans-only
- English language
- All ages (children and adults)
- Original research report
- Conducted in US or Canada
- Published prior to August 2020
- Compared RPWE against either urban or whole population with respect to outcome (e.g., prevalence, medication, insurance, access)

Exclusion

- Case reports
- Opinion pieces
- Editorials
- Book chapters
- Reviews
- Reports describing rural sub-group but without specific analysis investigating health outcomes compared to other population

b. CONSORT Flow Diagram

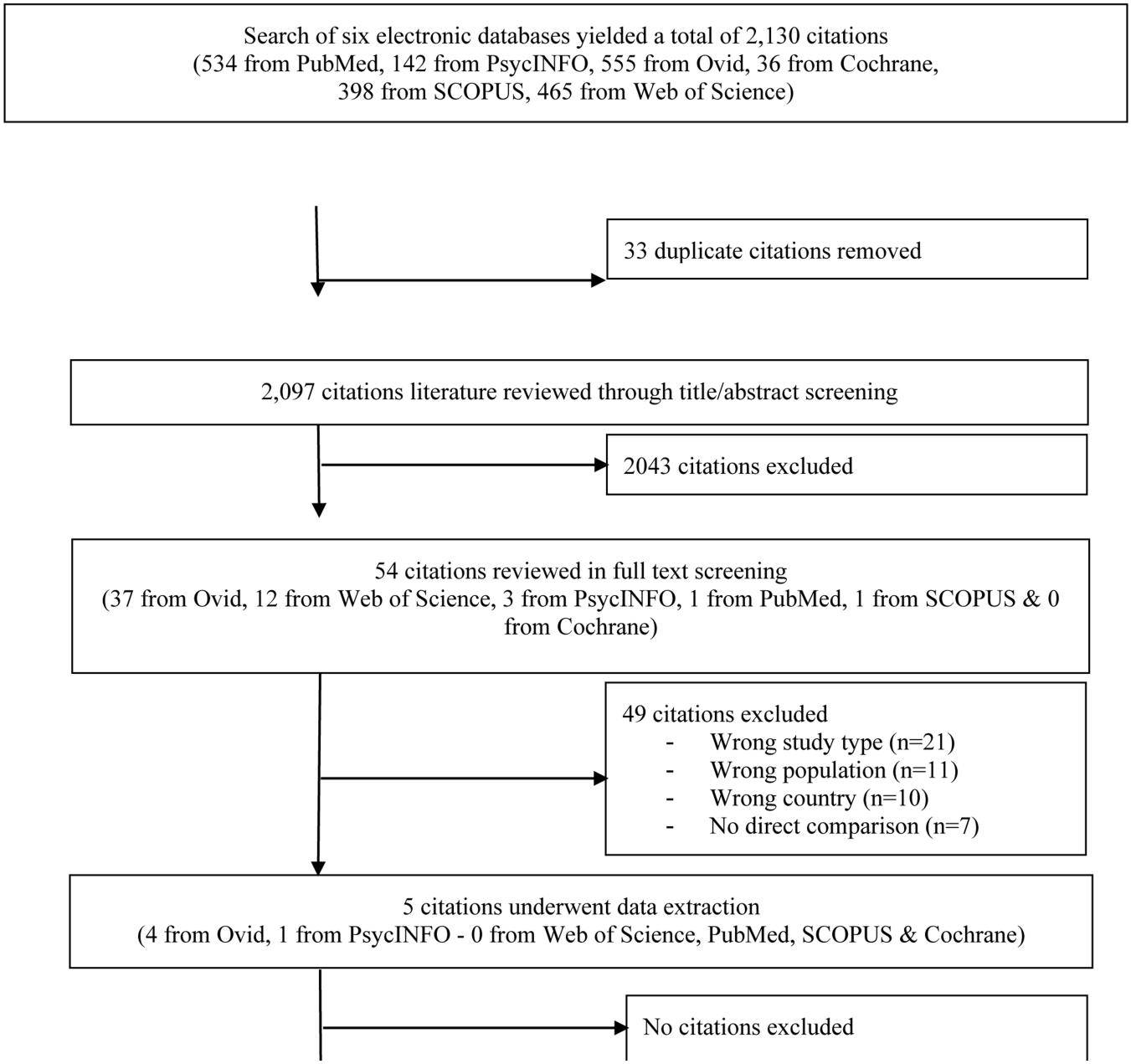

Figure 1. Article Selection a. Inclusion/exclusion Criteria b. CONSORT Flow Diagram

Table 1.

Characteristics of Included Papers

Article	Study Design	Study Period	Sample Size; Population	Epilepsy Definition[t]	Rural Definition	Outcome Measures	Health Disparities Measures
Wilson et al., 2016 (South Carolina)	cohort	2000 – 2013	62794; PWE visiting hospital, emergency department (ED) or clinics	a) ≥2 visits for epilepsy b) 1 visit for epilepsy AND priorvisit for unspecified seizure c) ≥2 visits for unspecified seizure within 1yr d) 1 visit for unspecified seizure AND procedure suggestive of epilepsy	Rural Urban Commuting Area (RUCA) codes	all-cause mortality	race, sex, age at earliest visit for epilepsy, SES (median income of the zip code of residence), insurance status
Selassie et al., 2015 (South Carolina)	cohort	2000 – 2011	13098; children (≤18 years) with epilepsy in hospital, ED, clinic or multiple causes of death dataset	visit for epilepsy OR unspecified seizure	Office of Management and Budget (OMB) county code	all-cause mortality	race, sex, age, insurance status
Banta et al., 2015 (California)	cohort	2009 – 2011	139235; PWE visiting ED	visit for epilepsy	not defined	areas of increased ED visits for epilepsy	PATIENT-LEVEL: race, sex, age, insurance status AREA-LEVEL: age distribution, sex, race, household status, % household members not related to head of household, employment rate, per capita income, % poverty
Jetté et al., 2008 (Alberta)	cohort	2001	1431; PWE visiting hospital, emergency department (ED) or clinics	visit for epilepsy in 1999 AND 2000	if second digit of postal code was “0” AND if government contractor defined postal code as “rural enumeration area centroid”	health resource utilization	sex, age, SES (welfare status), aboriginal status
Schiariti et al., 2009 (British Columbia)	crosssectional	2002 – 2003	5621; children (≤19 years) with epilepsy utilizing health services	visit for epilepsy, convulsions, myoclonic seizures OR for “other/epilepsy”	areas with population < 10,000	prevalence	sex, age, SES (neighborhood income)
Kozyrskyj & Prasad, 2004 (Manitoba)	crosssectional	1998 – 1999	1536 *; children (≤19 years) with epilepsy interacting with healthcare system	visit for epilepsy OR Rx for AED	not defined	prevalence	sex, age, SES (neighborhood income), age-specific treatment prevalence rates (prescription information)

* not reported formally - extrapolated from population multiplied by prevalence rate

tdiseases defined by the International Classification of Diseases, 9th revision (ICD-9) codes 345 (epilepsy), 780 (convulsions), 780.39 (seizure, not otherwise specified), 333 (myoclonic seizures) and V17.2 (other/epilepsy)

$NOS: modifed Newcastle-Ottawa Score