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ILAE Report

Epilepsy in North America
A Report Prepared under the Auspices of the Global Campaign against Epilepsy, the International Bureau for Epilepsy, the International League Against Epilepsy, and the World Health Organization

*William H. Theodore, †Susan S. Spencer, ‡Samuel Wiebe, §John T. Langfitt, ¶Amza Ali, ‖Patricia O. Shafer, **Anne T. Berg, and ††Barbara G. Vickrey

*National Institutes of Health, Bethesda, Maryland; † Yale University, New Haven, Connecticut; ‡University of Calgary, Calgary, Alberta; §University of Rochester, Rochester, New York; ¶University of the West Indies, Kingston, Jamaica; ‖Beth Israel Deaconess Medical Center, Boston, Massachusetts; **Northern Illinois University, Dekalb, Illinois; and ††University of California, Los Angeles, California*

Summary: In North America, overall epilepsy incidence is approximately 50/100,000 per year, highest for children below five years of age, and the elderly. The best data suggest prevalence of 5–10/1000. Potential effects of gender, ethnicity, access to care and socioeconomic variables need further study. Studies of epilepsy etiology and classification mainly were performed without modern imaging tools. The best study found an overall standardized mortality ratio (SMR) for epilepsy relative to the general population of 2.3. There is evidence to suggest a greater increase in patients with symptomatic epilepsy, particularly children. People with epilepsy are more likely to report reduced Health-related Quality of Life than controls. They have reduced income, and are less likely to have full-time employment. They suffer from persistent stigma throughout the region, in developed as well as developing countries. Poor treatment access and health care disparities for people with epilepsy may be related to insufficient economic resources, rural isolation, gender, ethnicity, and lack of public and physician knowledge of modern approaches to epilepsy care. Despite high costs and severe disability, epilepsy may attract somewhat less research funding from public and private sources than other less common chronic neurological disorders. A Plan for Epilepsy in North America should address: basic and clinical research; primary prevention research; translation to care; stigma, quality of life, and self-management; industry relations; government and regional relations; and regional integration and resource sharing. **Key Words:** Seizures—Incidence—Prevalence—Treatment resources—Stigma—Cost—Research.

More than 3 million people in North America have epilepsy. Diagnostic access, resources, medications, specialists, and facilities are limited in number, distribution, and quality, hindering care. Public awareness is limited: more common than multiple sclerosis, Parkinson's disease, or autism, epilepsy receives less research funding. Patients and family members often try to hide epilepsy, hindering treatment.

The Global Campaign against Epilepsy (GCAE), a joint effort of the International League Against Epilepsy (ILAE), International Bureau of Epilepsy (IBE), and World Health Organization (WHO), has been preparing a series of world Regional Reports on epilepsy (available online at http://www.whoint/mental_health/neurology/regionalreports/en/index.ht). The North American Report presented here is a modified and shortened version of the GCAE Report, placing additional emphasis on issues such as research that may have more relevance to the North American context than to the world as a whole. Based on literature review, survey results, web-based research, and direct inquiry, it was prepared by an ILAE working group, including neurologists, epidemiologists, epilepsy nurse specialists, and experts in health care outcomes. Each contributor was responsible for his or her own literature search. One important limitation is that,

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Address correspondence and reprint requests to Dr. W.H. Theodore at NIH Building 10 Room 5N-250, Bethesda, MD 20892, U.S.A. E-mail: theodorw@ninds.nih.gov
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TABLE 1. *Health and economic data, North American countries*

	Population 2003	GDP per capita	Infant mortality / 1,000	Life Expectancy m/f	Health expenditure %GDP	Health expenditure per capita	UN Human Development Index**
Antigua and Barbuda	73,000	11,000	19.5	70/75	4.8	538	.797
Bahamas	314,000	18.800	25.2	62/69	6.9	1074	.832
Barbados	270, 000	17,000	12.5	71/75	6.9	1018	.878
Belize	256, 000	6,800	25.7	67/70	5.2	299	.753
Canada	31510,000	32,800	4.8	77/84	9.5	2931	.949
Cayman Islands	42,000	32,300	8.2	77/83	[a]	[a]	[a]
Dominica	79, 000	5,500	14.2	72/78	6.4	310	.783
Grenada	80,000	5000	14.6	63/66	5.7	465	.787
Jamaica	2650,000	4300	12.4	72/75	6.0	234	.738
St. Kitts and Nevis	42,000	8,800	14.5	69/75	5.5	667	.834
St. Lucia	149,000	5,400	13.5	70/77	5.0	306	.772
St. Vincent and the Grenadines	120,000	2,900	14.8	72/76	5.9	340	.755
Trinidad and Tobago	1303,000	12,700	24.3	66/68	3.7	428	.801
U.S.A.	294,000,000	41,800	6.5	75/81	14.6	5274	.944

The GDP and Health expenditure figures are given in "international dollar equivalents" or "purchasing power parity." In the UN Human Development Index, Norway, at .963, is highest; >0.8 is "high"; >0.5 is "medium."

[a]Data not available.

Data from

1. U.S. Department of State: Bureau of Western Hemisphere Affairs, http://www.state.gov/p/wha/ci/
2. http://www.cia.gov/cia/publications/factbook/index.html
3. World Health Organization, http://www.who.int/countries/en/
4. http://hdr.undp.org/reports/global/2005/pdf/HDR05˙HDI_pdf

for countries other than the United States and Canada, few data are available. Some were derived from GCAE questionnaires returned by local authorities, particularly in the English Speaking Caribbean (ESC), and data collected in Jamaica and the Cayman Islands by Dr. Amza Ali.

Table 1 shows some basic data for WHO North American Region (NAR) countries. Gross domestic product per capita varies yearly, as well as, to some extent, from source to source, and figures should be taken as a relative guide. Nevertheless, all NAR countries fall into United Nations "medium" or "high" human development categories.

In this report, we review data on incidence, prevalence, etiology, mortality, social consequences, and available diagnostic and therapeutic interventions, including personnel, equipment, resources, inpatient and outpatient facilities, access, and costs in the NAR countries. We describe opportunities for, and impediments to, research. In the conclusion, we attempt to summarize major problems and suggested approaches, relate the problem of epilepsy to wider aspects of public health and medical care provision in NAR, and propose development of an Epilepsy Plan for North America.

EPILEPSY INCIDENCE AND PREVALENCE

United States

Definitions of epilepsy and methods of verifying diagnosis in epidemiologic studies (usually self-report) leave room for considerable error. The single best U.S. incidence estimates come from Rochester, Minnesota (1935 through 1984): in 44 per 100,000 people per year, epilepsy developed (Table 2) (Hauser et al., 1993). For the decade 1975–1984, the figure was 48 per 100,000 people per year. Males had a slightly higher incidence rate. Rates were highest for children younger than 5 years and the elderly.

One other study, performed in a Texas health maintenance organization (HMO) population, found overall incidence of 35.5 per 100,000 per year, 41.9 per 100,000 for men versus 20.7 per 100,000 for women (Annegers et al., 1999). This sample may have been younger than the general U.S. population, with a higher percentage of working and insured people.

TABLE 2. *Incidence of epilepsy per 100,000 per year by age in Rochester*

Age (yr)	1935–1984	1975–1984
0 to 1	86	79
1–4	62	53
5–9	50	52
10–14	39	46
15–19	44	43
20–24	39	38
25–29	30	32
30–34	23	22
35–39	33	32
40–44	26	26
45–49	23	23
50–54	31	32
55–59	32	31
60–64	40	45
65–69	55	58
70–74	88	112
75–79	111	104
80–84	158	239
85+	180	269
Total	44	48

In Rochester, incidence was 60–70 per 100,000 per year among people younger than 5 years, decreasing in adolescents and young adults to ~45 per 100,000 and to <30 per 100,000 in older adults. Rates increase starting in the early 1960s, become comparable to young children by the early 1970s, and twice as high as early childhood rates by the late 1970s (~150–200/100,000). A study in New Haven, Connecticut, found an incidence of 71/100,000 for white males, and 61/100,000 for white female children (younger than 15 years) (Shamansky and Glaser, 1979). For black children, figures were 159/100,000 and 103/100,000, respectively.

Averaging data on male and female patients, incidence rates were as follows: white non-Hispanic, 65/100,000; white Hispanic, 72/100,000; African-American non-Hispanic, 131/100,000; and African-American Hispanic, 162/100,000. The black–white differences were statistically significant, even after correction for age and sex. This study, performed in the 1960s, included everyone in the population regardless of insurance (Shamansky and Glaser, 1979). In contrast, the Texas HMO study found no differences among white, African-American, and Hispanic incidence; in the very small Asian population, incidence was 75% lower, perhaps reflecting random statistical fluctuations (Annegers et al., 1999).

In a large population-based epidemiologic study of status epilepticus in Richmond Virginia, the incidence of status epilepticus in the population was higher in nonwhites versus whites (DeLorenzo et al., 1996). This discrepancy was particularly pronounced in infants and in the elderly.

Two studies of risk factors for febrile seizures yielded conflicting results about a potential association with race. In a matched case–control study performed in Seattle, Washington, controls were less likely to be nonwhite (6.6%) compared with cases (13.6%) (Cassano et al., 1987). In a separate matched control study conducted in the Bronx, New York, only 5% of controls were white compared with 10% for cases (Berg et al., 1995). The two groups had comparable proportions of black children (18% controls and 19% cases), but the control group had somewhat more Hispanic children than the case group (77% vs. 71%). None of these differences was statistically significant.

Epilepsy prevalence at any age represents accumulation of unresolved surviving plus new incident cases (Table 3). In Rochester, prevalence—defined as one or more seizures within 3 years or currently taking antiepileptic drugs (AEDs) for seizures—appeared to increase gradually through childhood, plateauing in adult life before peaking in old age. Prevalence rose from 2.73/1,000 on January 1, 1940, to 6.79/1,000 on January 1, 1980 (Hauser et al., 1991). This was not explained by aging of the population, as the age-adjusted prevalence figures were nearly identical to the unadjusted (age adjusted to the 1980 U.S. population).

Rochester data from 1980 suggest increasing prevalence during childhood (1.41/1,000 in children younger than 5 years) through the mid 1930s (6.32/1,000). In the oldest age group (older than 75 years), however, the prevalence clearly jumps and reaches 14.08/1,000 (Hauser et al., 1991) (Table 3). A Copiah County, Mississippi, study found nearly identical overall prevalence, but less variation by age: 8.37/1,000 in children younger than 5 to 13.12/1,000 in 40- to 59-year-olds. The 60+ year category had lower prevalence (8.44/1,000) (Haerer et al., 1986). An Oklahoma study (Cowan et al., 1989) suggests an increase from age younger than 1 to age 2 (3.29 to 6.44/1,000) but declines to 3.5 to 4/1,000 by age 19 years.

The Rochester and Mississippi prevalence estimates are somewhat higher than a 1994 CDC survey, based on self-report of a seizure, convulsion, or blackout in the preceding 12 months (CDC, 1994). Patients well controlled on medication might not have been counted in this survey.

The 2003 and 2004 South Carolina Behavioral Risk Factor Surveillance System (BRFSS), a telephone survey of 13040 adults, suggested an estimated 2.2% (95% CI, 1.8–2.5%) of South Carolina adults had ever had epilepsy and that 1.1% (CI, 0.9–1.4%) had active epilepsy; 50.5% (CI, 38.9–62.1%) of the latter had seizures during the preceding 3 months (CDC, 2005).

In Rochester and Copiah County studies based on medical diagnoses, males had higher prevalence (Haerer et al., 1986; Hauser et al., 1991). In contrast, two studies found lower self-reported epilepsy prevalence in men than in women (CDC, 1994, Kobau et al., 2004).

Two childhood studies reporting prevalence by sex found slightly higher rates in boys than in girls. In Atlanta, Georgia, among 10-year-olds, the prevalence was 6.7/1,000 in boys versus 5.2/1,000 in girls (Murphy et al., 1995). The Oklahoma study of ages 0–19 years found a prevalence of 5.02/1,000 in boys versus 4.40/1,000 in girls (Cowan et al., 1989). A similar pattern was seen in Rochester for 1940–1970 (Hauser et al., 1991).

TABLE 3. *Prevalence of active epilepsy per 1,000 by age in various U.S. reports*

Age (yr)	Rochester (Hauser et al., 1980)	Mississippi (Haerer et al., 1986)	U.S. overall	Georgia & Tennessee (Kobau et al., 2004)
0–4	1.41	8.37	4.0	Not reported
5–9	3.92	9.74		
10–14	6.25			
15–24	6.22	11.49	5.2	
25–34	6.32			1.8
35–44	9.17	13.12		2.5
45–54	7.61			2.7
55–64	7.72	8.44		
65–74	6.83		3.1	1.0
75+	14.8			
Total	6.79	6.78	4.7	2.1

The U.S. overall and Kobau et al. figures are based on self-reports.

TABLE 4. *Prevalence per 1,000 of active epilepsy by race, U.S.*

Location/study	White	African-American	Hispanic	Other
Copiah County (Haerer et al., 1986)	5.36	8.23	NR	NR
Atlanta (Murphy et al., 1995)	5.7	6.4	NR	NR
Oklahoma (Cowan et al., 1989)	4.21	4.76	NR	4.49
U.S. (Centers for Disease Control, 1994)	4.5	6.7		
Tennessee & Georgia (Kobau et al., 2004)	2.1	2.0 (nonwhite or Hispanic)	NR	NR

NR, not reported; MMWR, Centers for Disease Control Morbidity and Mortality Weekly Reports.

Most (Haerer et al., 1986; Cowan et al., 1989; CDC, 1994; Murphy et al., 1995) but not all (Kobau et al., 2004) studies found higher epilepsy prevalence in African Americans (Table 4). The two studies in children that have examined this issue found a similar disparity in children (Cowan et al., 1989; Murphy et al., 1995). There are no published epidemiologic studies among Native Americans, but anecdotal experience suggests a higher prevalence (personal communication, Karen Parko, M.D., 2004). The only report addressing regional differences found comparable prevalence figures in the West (4.0/1,000), Northeast (4.4/1,000), Midwest (4.9/1,000), and South (5.0/1,000) (CDC, 1994).

Canada

Based on an overall epilepsy incidence of 40–70/100,000, Canada's 2003 population of 31 million would have ∼15500 new cases per year (Kotsopoulos et al., 2002). One study reporting neonatal incidence (2.6 per 1,000 live births, 2.00 for term neonates, 11.1 for preterm neonates, and 13.5 for infants weighing <2,500 g at birth) suggests that clinical seizures occur 6 times more often in preterm than in term infants (Ronen et al., 1999). Epilepsy incidence was 118/100,000 for children younger than 1 year, 48/100,000 from 1 to 5 years, 43/100,000 from 6 to 10 years, and 21/100,000 from 11 to 15 years (Camfield et al., 1996).

Prevalence data were derived from three sources: The Ontario Health Survey (Wiebe et al., 1999) (61239 subjects), representing the largest province in Canada; the Community Health Survey (Tellez-Zenteno et al., 2004) (130822 subjects); and the National Population Health Survey (Statistics Canada, 2001) (49026 subjects). Active adult epilepsy prevalence was 5–10/1,000 (Camfield et al., 1996; Wiebe et al., 1999; Statistics Canada, 2001; Tellez-Zenteno et al., 2004) (Table 5). Prevalence in Manitoba children was 4.49 per 1,000 (Kozyrskyj et al., 2004).

People with low educational or income levels, and the unemployed, had higher epilepsy prevalence. Studies from developing and developed countries suggest higher prevalence rates in lower socioeconomic strata (Gudmundsson et al., 1963; Gomez et al., 1978; Osuntokun et al., 1987; Wang et al., 2003). A recent study found the same trend in an urban Canadian pediatric population (Kozyrskyj et al., 2004).

The prevalence of epilepsy was significantly lower in Canadian immigrants (3.6/1,000) than in nonimmigrants (6.1/1,000), and in "other races" (4/1,000) than in whites (5.8/1,000). No differences by gender were found.

Prevalence in provinces near the West Coast was 30% (statistically significant), lower than in the rest of Canada. An apparent higher prevalence in provinces near the Atlantic was not statistically significant (Statistics Canada, 2001).

ESC

In the Cayman islands, record review of AEDs prescribed through government hospital and district clinic pharmacies over a 6-month period, and of government hospital admissions and EEG reports over a 2-year period identified 118 PWE. Patients using private health services,

TABLE 5. *Prevalence of epilepsy in Canada per 1,000 by age*

Age (yr)	CHS (1) Weighted prevalence (95% CI)	OHS (2) Weighted prevalence	NPHS (3) Weighted prevalence	NPHS (3) 1996–1997 (99% CI)	NPHS (3) 1998–99 (99% CI)
0–4				3.79 (3.27–4.38)	3.46 (2.96–4.05)
5–9				3.60 (3.11–4.17)	3.63 (3.13–4.20)
0–11		3.1	2.5 (2.1–3.0)		
10–14				4.42 (3.87–5.06)	4.61 (4.04–5.26)
12–14	2.9 (1.9–4.0)	5.7	4.4 (3.4–5.8)		
15–19				6.23 (5.55–6.99)	7.19 (6.46–8.0)
16–24	4.8 (4.2–5.5)	4.3	3.6 (3.0–4.2)		
25–44	6.2 (5.7–6.7)	5.9	6.0 (5.4–6.6)		
46–64	6.5 (5.9–7.1)	4.9	5.3 (4.7–5.8)		
>65	4.1 (3.5–4.8)	7.2	6.9 (6.0–7.8)		
Total	5.6 (5.1–6.0)	5.8	5.2 (4.9–5.4)	4.49 (4.20–4.80)	4.72 (4.40–5.0)

1, Community Health Survey; 2, Wiebe et al., 1999; 3, National Population Health Survey; CI, confidence interval.

not taking medication, or eschewing follow-up were missed, unless they needed hospital admission or were identified by chance. Fifty-eight were male; mean age was 36 years (0–84 years). Onset age was younger than 20 in 54, 20–59 years in 39, older than 60 years in 14, and unknown for 11. Seizure type rarely was well described. The term "seizures" was used interchangeably with "generalized" or "tonic–clonic"; 58% had active (seizures within 2 years), and 8%, inactive epilepsy (34% had insufficient information). Fewer than 10 yearly hospital admissions for epilepsy were found.

In Jamaica, >8000 epilepsy admissions occurred from 1996 through 2002, accounting for 0.94% of all public hospital admissions. Higher numbers were observed among males for each year listed (male-to-female ratio was 1.2:1). The average length of hospital stay was 8.9 days.

CLASSIFICATION AND ETIOLOGY

United States

In Rochester from 1935 to 1984, approximately two thirds of cases were cryptogenic (no identifiable condition or insult) or idiopathic (one of a group of mostly childhood-onset epilepsies were presumed to have a genetic basis). The rest occurred in patients with identified insults (Annegers et al., 1996); 3.5% had neurodegenerative disorders, 2.5% had intracranial infections, 4.1% tumors, 10.9% vascular accidents or related causes, 5.5% trauma, and 8% encephalopathies believed to be of pre- or perinatal origin (e.g., children with cerebral palsy or mental retardation). Two extremely important limitations of these data are that (a) they are entirely pre-MRI and largely pre-CT, and (b) they reflect causes in a predominantly white, northern mid-twentieth century urban population. Causes of epilepsy are highly population and time dependent.

In a childhood cohort (younger than 16 years at epilepsy onset) studied in the mid-1990s in Connecticut, approximately one third had idiopathic, and almost half had "cryptogenic epilepsy" (negative history, normal neurologic examination and imaging) (Berg et al., 1999). In the remaining 20%, ~7% had presumed intrauterine insults, 2% had documented perinatal stroke or hypoxia, ~3% had brain malformation, ~1% had an intracranial infection, 1% had a tumor, ~2% had neurocutaneous syndrome, ~1% had a chromosomal abnormality, ~1% had autism, and ~1% had a neurodegenerative disorder. The age distribution differs markedly from that in Rochester, and most children in this study had neuroimaging (Berg et al., 2000). Thus results cannot be directly compared.

The Texas-HMO study found that the disorder in 75% of children and adults had an idiopathic or cryptogenic etiology (Annegers et al., 1999). Cerebrovascular disease was the most common identified cause, followed by tumors, trauma, and seizures associated with developmental disabilities.

Canada and ESC

No overall Canadian epilepsy etiology studies exist. In neonates, presumed etiology was hypoxic–ischemic encephalopathy in 40%, infections in 20%, and metabolic abnormalities in 19% (Ronen et al., 1999). In Jamaica, 19.5% of patients with epilepsy had a history of significant antecedent head injury, and 15% had substance abuse (alcohol, cigarette, marijuana; no admissions to cocaine use). A family history of epilepsy was elicited in 29 (14.9%) patients, with 14 of 29 individuals reporting occurrence in a first-degree relative. From 52% to 56% of patients had generalized tonic–clonic seizures (GTCSs) without reported aura. The next most frequent seizure type was complex partial seizures (14%); 42% were classified as localization related.

On the Cayman Islands, 45% were thought to have localization-related epilepsy (31.5% symptomatic). In 45% of patients, an underlying etiology was presumed. The most common was "cerebral palsy" or "congenital anomaly."

MORTALITY

United States

Rochester data (1935 through 1974) are the main source of U.S. epilepsy mortality information (Hauser et al., 1980). The average length of follow-up after initial diagnosis of epilepsy was ~13 years. The standardized mortality ratio (SMR) relative to the general population was 2.3. The increase was not related to etiology: cryptogenic/idiopathic SMR was 1.8, and remote symptomatic (postneonatal), 2.2. Individuals with congenital neurologic disorders, however, had a sharply increased mortality rate (SMR, 11.0).

Regardless of etiology, excess deaths were seen across a broad range of causes, neoplasms (including non-CNS neoplasms), cerebrovascular disease, accidents, influenza and pneumonia, and other disease of the circulatory system.

It is interesting that recent U.K. data showed only a very small nonsignificant increased risk in the nonsymptomatic group (SMR, 1.3) and a substantial increased risk in the symptomatic group (SMR, 3.7). In those with "congenital" neurologic disorders, the SMR was 25 (Shorvon, 2001).

The other U.S. source of information is based on a community cohort with childhood onset (younger than 16 years at initial onset) followed up for a median of 8 years (Berg et al., 2004). A small nonsignificant increased risk was found in those with nonsymptomatic epilepsy (SMR, 1.43), and substantially increased in children with symptomatic epilepsy (SMR, 33.46). These results were comparable to Canadian (Camfield et al., 2002) and Dutch (Callenbach et al., 2001) studies.

Canada

In children, SMR was 5.3 (95% CI, 2.29–8.32) in the 1980s and 8.8 in the 1990s (95% CI, 4.16–13.43) (Donner et al., 2001). In a population-based study, pediatric epilepsy mortality in Nova Scotia was 5.3 times higher (95% CI, 2.29–8.32) than in the reference population in the 1980s and 8.8 times higher (4.16–13.43) in the 1990s (Hauser et al., 1980). Sudden unexplained death in epilepsy (SUDEP) incidence was 0.11 per 1,000 person years. In children, SUDEP incidence was 0.2 per 1,000 person years (Donner et al., 2001). In Saskatchewan, the minimum SUDEP incidence was estimated at 0.54, and the maximum at 1.35 cases per 1,000 person years (Tennis et al., 1995).

U.S. and Canadian data suggest that mortality in nonsymptomatic epilepsy is only minimally increased over that expected in the population, if at all. In patients with underlying symptomatic causes, mortality is substantially increased. However, no data allow a distinction between mortality due to the underlying cause and symptomatic epilepsy per se.

QUALITY OF LIFE

United States

A few studies have examined systematically overall health-related quality of life (HRQOL) of U.S. people with epilepsy (PWE) (Collings, 1990; Baker et al., 1998). The Texas Behavioral Risk Factor Surveillance System (BRFSS) is an ongoing, state-based, random telephone survey of noninstitutionalized civilians 18 years or older, weighted to reflect age, sex, and racial/ethnic distribution of the state's estimated population during the survey year (CDC, 1997). PWE were defined as those who reported having been told by a doctor that they had epilepsy or a seizure disorder. In Texas in 1998, 52 (1.8%) (95% CI, 1.4–2.1) of 3,355 respondents reported having epilepsy (CDC, 2001); 45.9% of PWE reported poor HRQOL compared with 18.5% without epilepsy. PWE reported 4.4 more physically, and 5.2 more mentally unhealthy days, 4.0 more recent activity limitation days, 6.8 more days of pain, 5.2 more days of anxiety, 3.5 more days of insufficient sleep or rest, and 3.3 fewer days of vitality in the 30 days preceding the survey (CDC, 2001). Findings are comparable to those for unhealthy days for BRFSS respondents with chronic diseases including arthritis, heart problems, diabetes, and cancer (CDC, 1998). Potential contributors to unhealthy days in PWE include seizure severity, injuries, and AED toxicity. The high number of depression and anxiety days suggests high anxiety and low life-fulfillment levels (Collings et al., 1990; Trimble and Dodson, 1994; Baker et al., 1998).

In the South Carolina BRFSS survey, 46.76% of those with epilepsy (ever had it or active epilepsy) reported disabling factors, compared with. 17.9% without epilepsy. People who took medications for seizures reported worse HRQOL than did those not taking medications, and those with active seizures reported more problems and limitations than did those with controlled or inactive seizures (CDC, 2005).

BRFSS has at least four limitations. It uses self-reported data, excludes persons unreachable by private phone, living in institutions (e.g., nursing homes and the military), or younger than 18 years. It may underrepresent the severely impaired because time and functional capacity are required to participate in the survey. PWE number was small, and comparisons by sex and racial/ethnic subgroup limited.

In spring 1993, a telephone survey conducted by INFO Research, Inc., examined the concerns of PWE and contrasted their responses to those of the general population (Roper Organization, 1992). Three hundred thirty-one PWE, including 100 patients still experiencing seizures despite therapy, as well as a nationally projectable sample of 1,000 members of the general public, were surveyed.

Employment and financial differences were striking. PWE had an average income of $18,750 compared with $32,000 for the general public. Thirty-three percent had household incomes of <$12,500 compared with 15% of the general public. Only 39% of PWE were employed full-time, compared with 55% of the general public; 33% were not employed at all, compared with 13% of the public. These perceptions and observations highlight significant quality-of-life impairments in the epilepsy population in the United States.

In a national survey of 1023 people with epilepsy, respondents listed uncertainty and fear of having a seizure as the worst aspects of epilepsy. Life-style, school, driving, and employment limits were other major problems. Cognitive impairment was ranked the highest potential problem. Thus PWE and their families, even in a sample in which the majority report good seizure control, report ongoing medical and psychosocial problems (Fisher et al., 2000).

Data suggest that PWE have ~12% lifetime suicide prevalence compared with 1.1–1.2% in the general population. The increased risk appears to affect children and adolescents as well as adults. Suicide-attempt rates (a significant risk factor for subsequent completed suicide) are elevated among PWE. Psychiatric comorbidity is common, and rates of mood disorders, particularly major depression, are elevated, probably contributing to suicide risk (Jones et al., 2003).

Canada

Significantly more PWE had low annual income compared with those with other common chronic conditions (Wiebe et al., 1999) (Table 6). Quality of life, as measured by Dupuy's Psychological General Well-Being Scale, was significantly lower in PWE than in those with

TABLE 6. *Ontario Health Survey: Income and occupation in epilepsy versus other populations in Canada*

Variable	General population	Chronically ill	Epilepsy
Annual household income (%)			
Low	13.7	14.5	22.2
Not low but <$50,000	39.8	39.9	36.0
>%50,000	47.5	45.6	41.8
Occupation (%)			
Office	58.1	59.8	63.4
Service of transportation	16.1	15.9	9.5
Primary Quality of life	25.8	24.3	27.1
PGWB mean scores (±95% CI)	31.4 ± 0.1	31.0 ± 0.2	26.1 ± 0.2
PGWB score categories (%)			
0–12	1.6	2.0	6.1
13–24	16.1	18.0	36.4
25–30	21.5	21.6	23.9
31–42	60.8	58.4	33.6

Higher scores in the quality-of-life measure indicate a better quality of life.

other chronic conditions. One or more barriers to health care were reported by 22.75% and 7.45% of epilepsy and chronically ill respondents, respectively. PWE were less likely than the general population to complete secondary and postsecondary education (odds ratio, 0.8 at each level).

ESC

Cayman islanders enjoy a high quality of life with good social services. However, no specific facilities are available for PWE, who face concerns regarding education, employment, and driving. In a British Crown Colony, U.K. rules apply. Patients must be seizure free for 1 year or have seizures confined to sleep for 3 years and not be a source of danger to the public. Driving is prohibited until 6 months after medication changes. For a commercial license, patients must not be taking medication, have had no seizures for 10 years, nor have an underlying risk for continued seizures. In the Cayman Islands, most individuals with epilepsy do not drive. Fortunately, this is a lesser handicap than expected because of the small size of the island.

Most Cayman Island PWE are undereducated and under/unemployed. Although most children are integrated in mainstream schools, individuals with mental retardation and epilepsy attend the Sunrise School, a facility dedicated to the care of those with mental retardation. The most severely affected children with epilepsy receive no schooling or vocational activity and are generally looked after at home or institutionalized.

Social issues/driving/employment/stigma are cited as important obstacles by health professionals in Jamaica, Barbados, and Grenada, and PWE in Barbados, Grenada, and Trinidad/Tobago.

STIGMA

United States and Canada

Stigma has been defined as the relation between "The differentness of an individual and the devaluation society places on the particular differentness" (Dell, 1986). U.S. public policies have not been able to dispel perceptions of epilepsy as a stigmatizing condition; stigma against epilepsy remains high in developed countries such as the United States and Western Europe (Baker et al., 2003).

Epilepsy is not just a clinical disorder but a social label; social prognosis may be less optimistic than clinical, particularly people in resource-poor countries. Persistent conceptions of epilepsy as a mental illness reinforce stigma in developed as well as developing regions; 22% of American adolescents studied did not know whether epilepsy is a contagious disorder (Austin et al., 2002a).

Popular perceptions of epilepsy, based on "grand mal" seizures, lead to the idea that all patients have chronic and incapacitating epilepsy, ignoring the diversity of the disease (Jacoby et al., 2005).

Stigma can be conceptualized at three levels: internalized or "felt," and enacted, including interpersonal and institutional interactions (Dell, 1986). Internalized or felt stigma reflects a person's feelings, thoughts, or fears of feeling or being treated as "different," whereas interpersonal stigma relates to relationships that may affect how the person with seizures is treated or perceived by others. Research findings relating to institutional stigma, or how people with epilepsy are treated in society, are sparse.

In the INFO Research survey, most Americans (89%) had heard of epilepsy, and 51% knew someone with the condition (Roper Organization, 1992). However, the public tended to overestimate the severity of epilepsy and the limitations PWE face. Forty percent of the public believed PWE have seizures once a month or more, whereas only 22% of patients report having seizures that frequently. The general public thought that those with epilepsy needed to limit lifestyle activities more often than PWE thought themselves, including driving (64% compared with 38%), sports and fitness (49% to 30%), and social drinking (64% to 46%). The public overestimates the difficulties people with epilepsy face in dealing with prejudice/discrimination (66% compared with 50%), finding/holding a job (62% to 55%), and having a spouse/family (45% to 33%). The public overestimates the concerns of people with epilepsy in several areas, including public embarrassment (89% compared with 71%), depression (63% to 42%), not being in control (71% to 50%), and confidence and self-esteem (57% to 37%).

Children with seizures are thought to be particularly vulnerable to the effects of stigma. An impaired self-image may increase risk for mental health and social problems or impair seizure treatment. In a cross-sectional study, Austin and colleagues collected data from 170 children

with chronic epilepsy (mean age, 11.8 years; 91% white, 6% African American, 51% male) from schools, clinics, and physicians in private practices in a large Midwestern city (Austin et al., 2004). The total mean perceived stigma score of 2.24 fell between "sometimes" and "often." Higher perceived stigma in children correlated with parent stigma scores, younger age, younger age at onset of seizures, seizure severity, less self-efficacy in managing seizures, mood (worry about epilepsy, poor self-concept, and symptoms of depression), and attitudes (negative attitudes about having epilepsy).

Disclosing or talking about their epilepsy was a problem for 53% to 70% of adolescents, although 60–69% did not report stigmatizing behaviors or attitudes (Westbrook et al., 1992). Higher rates of perceived stigma were noted in younger adolescents with lower self-esteem. Stigma was a major factor affecting quality of life in a survey of 197 adolescents from 17 epilepsy centers in the United States, three in Canada, and three private practices (Cramer et al., 1999). Greater stigma scores were associated with lower health-related quality of life, socioeconomic status, and need for special education (Devinsky et al., 1999).

One community-based study designed to investigate the subjective experience of PWE used a randomized sample of 1,023 adults drawn from self-reported household data and callers to the Epilepsy Foundation toll-free line (Fisher et al., 2000a). A specific stigma scale was not used, but questions identified fear and uncertainty as the worst aspects of having epilepsy. Almost one fourth reported that social stigma, fear of other people's reactions, shame, and loneliness were major concerns. Younger respondents indicated more concern with social stigma, and older, with impact on other aspects of daily living.

Three hundred fourteen participants (mean age, 43; 50.3% female; 80% white; 16% black) from epilepsy centers in Boston, Massachusetts, and Atlanta, Georgia, completed a perceived stigma questionnaire using Austin's stigma scale for children, adapted to adults (DiIorio et al., 2003). No differences were noted in stigma scores in relation to age, gender, or ethnic background. Participants who were never married, or divorced, had lower educational attainment, and those who did not have paid employment or earned <$1,0000 reported greater stigma. Longer epilepsy duration, seizures in the past year, and perception of less seizure control and greater severity predicted higher perceived stigma. Associated behavioral factors with higher stigma included less confidence in managing epilepsy, negative expectation for seizures and outcomes, decreased patient satisfaction, and lower scores of medication self-management and adherence.

One hundred seventy-one parents of children with chronic seizures and 224 parents of children with new-onset seizures were evaluated by using a tool designed to measure parental stigma. The majority of caregivers were mothers. Children with new-onset seizures (mean age, 8.5 years; 75% white, 22% African American, 51% female) were enrolled within 6 weeks of their first recognized seizure in two Midwestern cities. Greater perceived stigma in parents of children with chronic epilepsy correlated with younger age (of parent and child), seizure severity, reduced sense of self-efficacy, and negative effects on family life and leisure. Parents of children with new-onset seizures demonstrated similar findings only in relation to mood and family life/leisure.

The perceptions of teens with seizures contrast with a recent Epilepsy Foundation study of 19,441 adolescents without epilepsy in the United States (53% female, 63% white, 14% black/African American, 12% Latino, 5% Asian) (Austin et al., 200b). Knowledge of basic seizure information was low: 67% did not know seizure first aid, 51% thought that people with epilepsy died of seizures, and 50% that epilepsy might be a form of mental illness.

Although epilepsy was the least feared of five health conditions, 40% did not know if people with seizures might be dangerous, and 46% said they could tell if a person had epilepsy by looking at them. Whereas 46% of teens reported that they would disclose epilepsy to friends if they had it and 69% wanted a friend to tell them if he or she had seizures, 58% thought that having epilepsy could make someone unpopular, and 69% were either uncertain or would not date someone with epilepsy. Thirty-seven percent of teens without epilepsy definitely thought that teens with epilepsy were more likely to be teased or bullied. These findings illustrate the social climate and challenges that teens with epilepsy face and differ markedly from earlier and smaller samples of children with epilepsy that suggest low levels of perceived stigma.

In a recent study of workers in a metropolitan charity, a trend toward more anxiety was noted at the thought of interacting with a coworker with epilepsy than with depression or multiple sclerosis. Worry about sudden, unpredictable behavior for the coworker with epilepsy was significantly greater than that for multiple sclerosis. The level of comfort regarding providing first aid for the coworker with epilepsy was significantly lower than for depression and multiple sclerosis. Lower job and income level correlated with more social discomfort for all three illnesses (Harden et al., 2004).

Demographic factors affect attitudes to epilepsy. A CDC study found that adults older than 65 had significantly more negative attitudes than those of all other ages, followed by adults aged 18–34. Blacks and Hispanics had significantly more negative attitudes than did whites, but did not differ significantly from each other. Persons with a high school diploma or less had significantly more negative attitudes than did those with more education, and rural dwellers more than suburban. Negative stereotypes

did not differ by employment status, but annual household income <$25,000 was associated with significantly more negative attitudes (Kobau et al., 2006).

Increasing cultural diversity in North America affects attitudes to epilepsy. A U.S. study compared a Spanish-language survey instrument administered to participants chosen from a Hispanic marketing research database in seven large U.S. Hispanic metropolitan areas, with the same survey administered in English to a random population sample. Spanish-speaking adults showed less familiarity with epilepsy. Hispanics, particularly those with less than a high school education, were more likely to regard epilepsy as contagious, or caused by "sins," and be likely to respond to "exorcism." However, the Hispanic sample had significantly lower income and education than the non-Hispanic sample (Sirven et al., 2005).

In a Canadian study, differences in beliefs and attitudes about epilepsy were assessed in "Caucasians," "South Asians," and "East Asians," by using the Epilepsy Beliefs and Attitudes Scale (Gajjar et al., 2000). Self-identified "Caucasians," people with more familiarity with epilepsy, and those with longer duration of stay in North America, were more likely to ascribe epilepsy to "neurologic" than to "metaphysical" (supernatural) causes. Age, gender, and education did not affect the results (Gajjar et al., 2000).

ESC

Generally, epilepsy is not viewed negatively in the Cayman population that, because of years of isolation, has a relatively high prevalence of genetic disorders, including lipid-storage disorders, the Cayman ataxia syndrome, spinocerebellar ataxias, and sickle cell disease. Although demonic possession is not a local belief, some myths contribute to a certain degree of stigma. A local practice is bathing in cold water (if the patient has a sensory aura) to abort the seizure.

In contrast, significant stigma exists against PWE in Jamaica, particularly in lower socioeconomic classes. Older individuals, especially in rural areas, ascribe epilepsy to demonic possession; a priest or the obeah-man is often sought to assist patients with recurrent seizures. Myths related to treatment of an individual with seizures in Jamaica include covering the nose of a patient having a seizure with an old, smelly leather shoe, or rubbing the patient down with thyme and scallion or alcohol. Some partners lie on top of their seizing spouse or child until the seizures stop. In urban areas, affected individuals, particularly children with a first seizure, are usually brought to a physician. More subtle manifestations (e.g., complex partial seizures) often lead to evaluation by a psychiatrist instead of a neurologist; the view is still widely held that epilepsy and madness are related. Legislation dating to 1938 prohibits driving by anyone with epilepsy. No requirement exists to report individuals with recent seizures to the Driving Authority.

Most PWE in the English-speaking Caribbean are un- or underemployed. The view is widely held, even among physicians, that affected individuals are a liability in the workplace. Many physicians believe that once medication is started, it is very unlikely that the patient can be taken off; hence the tendency for patients to take AEDs an unnecessarily long time, perpetuating stigmatization. Marriage is rare for people with preexisting epilepsy.

EPILEPSY CARE PERSONNEL

United States

Precise information about epilepsy personnel and resources is not available. Forty-one percent of American Academy of Neurology members surveyed in 2000 indicated that they considered epilepsy a focus of their practice (Swartztrauber, 2001). Extrapolating to the 2004 American Medical Association Physician Master file, ~4,000 U.S. neurologists (~2.4/1,000 PWE) routinely diagnose and treat epilepsy, and 2,500 (1.5/1,000 PWE) provide long-term care, with considerable overlap likely between these two groups.

Membership in the American Epilepsy Society includes 1,000–1200 adult "epileptologists" (neurologists spending >50% of their time on epilepsy), 200–250 pediatric epileptologists, 150–175 each epilepsy specialist nurses and neuropsychologists, and 75–100 neurosurgeons. Approximately 100 specialized epilepsy centers exist in the United States.

Distribution of neurologists is very uneven (Fig. 1). Using staffing levels for a large, West-Coast HMO as a benchmark, most of the 306 tertiary hospital-referral regions (HRRs) in the United States had a surplus of generalist and specialist physicians in 1996 (Center for the Evaluative Clinical Sciences, 1998); 258 of 306 HRRs had greater than the HMO benchmark of 1.84 neurologists per 100,000 residents. The greatest relative concentrations are in the Northeast and Midwest, with lower concentrations in the Great Plains and Southwest. Metropolitan regions

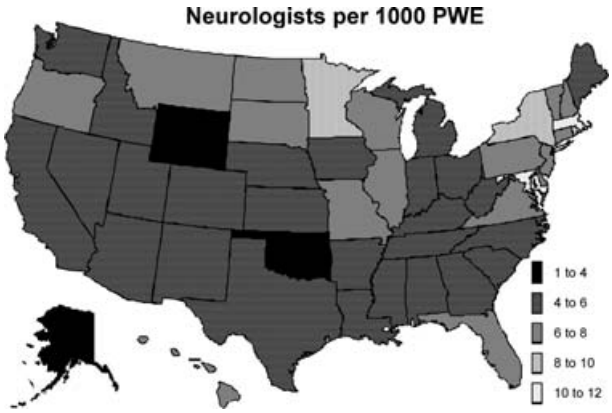

FIG. 1. Neurologists per 1,000 people with epilepsy by state in the United States.

TABLE 7. *Estimated epilepsy personnel in Canada and its provinces (2001)*

Region (population x10^6)	Neurologists	People/ Neurol	Estimated PWE	Epilepsy specialists	PWE per epileptologist	Epilepsy surgeons	PWE per surgeon
Ontario (11.41)	218	52,339	79,870	20	3,994	4	26,623
Quebec (7.24)	207	34,976	50,680	13	3,898	4	12,670
British Columbia (3.91)	75	52,133	27,370	10	2,737	3	9,123
Alberta (2.9)	53	54,717	20,790	6	3,465	6	3,465
Atlantic (2.3)	40	57,500	16,100	7	2,300	5	3,220
Manitoba (1.12)	18	62,222	7,840	1	7,840	1	7,840
Saskatchewan (0.98)	13	75,385	6,860	3	2,287	1	6,860
Northern (0.09)	0	—	650	0	—	0	—
Canada (30)	625	48,000	210,400	60	3,500	23	9,133

Population data pertain to the last Canadian Census, whereas epilepsy personnel figures are an approximation based on a survey by the authors in 2004.

PWE, people with epilepsy.

on the East Coast (Boston, New York, Washington, DC) had higher neurologist density; Rochester, Minnesota, was highest, at 9.4/100,000. Neurologist supply fell below benchmark in multiple regions in Louisiana, Texas, and Utah, with the lowest in McAllen, Texas (0.5/100,000).

Nationally, an oversupply of neurosurgeons is found. Only one HRR (Temple, Texas) did not exceed the HMO benchmark of 0.4 neurosurgeons per 100,000.

Approximately 80 epilepsy fellowship training programs are found in the United States, lasting 1–2 years. These programs usually enroll physicians who have completed neurology residency. Formal accreditation is being developed. A similar number of 1-year accredited clinical neurophysiology training programs exist, also requiring neurology residency; in these, formal epilepsy exposure receives less emphasis.

Canada and ESC

Fewer, but more uniformly distributed, epilepsy specialists and neurologists are found in Canada than in the United States (Table 7). In Jamaica, PWE generally are seen in acute care settings, and follow up with internal medicine clinics in public hospitals, or with general practitioners. More difficult-to-control patients or those with greater expectations are referred to Neurology Clinics of the Kingston Public Hospital and University Hospital of the West Indies or attend private offices of the two pediatric and five adult neurologists (all in the Kingston region; one specializing in epilepsy). Waiting lists are ~6 months for public and 2–3 months for private neurology clinics. The Cayman Islands have an excellent medical infrastructure, allowing good access to primary care physicians and emergency care. Approximately 125 physicians are found on the islands. Specialist access is limited. A Jamaican neurologist recently became available 3–5 days per month. Pediatric neurology is referred to a tertiary center in United States or Jamaica. Outside of the United States, Canada, and the single epilepsy specialist in Jamaica, no other epilepsy specialists exist in any NAR country.

EPILEPSY RESOURCES

United States

CT, MRI, single-photon emission computed tomography (SPECT), positron emission tomography (PET; because of its use in cardiology), and scalp EEG are nearly universally available at moderate-sized or larger hospitals (as well as in many private practice settings). Video-EEG, invasive electrode implantation, and neuropsychological study may be restricted to the ~100 specialized epilepsy centers. As yet no epilepsy center accreditation process exists beyond that standard for general hospitals. Expertise in procedures offered and techniques used may vary.

Almost all AEDs are available in the United States, with a few exceptions, such as vigabatrin (VGB) and clobazam (CLB).

Canada and ESC

In Canada, 45 video-EEG beds are found, in 22 separate epilepsy groups in 2002, with 326 CT, 147 MRI, and 14 PET scanners. Nonemergency procedures may require long waits. Most AEDs are available in Canada.

In Jamaica, nine (four high-quality spiral) CT scanners exist, and three good-quality MRI units, in Kingston and Montego Bay; the newest one in Montego Bay is run by a U.S. board-certified neuroradiologist. EEGs are available in the government service at Bustamante Hospital for Children (BCH) and three private centers. Two private facilities offer digital EEG. One private center offers EEGs at a 50% discount to all Government Hospitals and does ~30–40 EEGs per month. The chief technician is U.S. board certified in EEG and sleep.

In the Cayman Islands, CT and routine digital EEG are available locally (reporting must await the monthly neurologist visit), but not MRI or video-EEG.

According to the GCAE survey data submitted by several countries, CT, MRI, EEG, AED levels, psychiatric consultation, evaluation, and treatment for epilepsy are widely available, with the notable exception of Grenada (none of these) and Guyana (no drug levels or EEG noted).

But the extent of these services, and their accessibility, may be poor. Video-EEG (except a two-bed unit in Jamaica), surgical evaluation and treatment, advanced neuroimaging modalities, specialized rehabilitation services, and dedicated epilepsy treatment beds are all but nonexistent.

In general, phenobarbital (PB), phenytoin (PHT), carbamazepine (CBZ), and valproate (VPA) generally are available in the public sector in NAR outside the United States and Canada, at a cost most patients appear to be able to afford. Newer medications are hard to obtain in the public sector but are available if one can pay privately. Lack of epilepsy specialists may complicate use of such drugs.

TREATMENT ACCESS AND DISPARITIES

United States

Health care disparities exist throughout the NAR. In the United States, both economic and "ethnic" factors play an important role. Our knowledge of these disparities, which are influenced by "race," age, region, education, and income, is minimal.

U.S. health care is provided under a wide variety of insurance schemes, based mainly on employment. About 43.3 million people in the United States were uninsured in 2003, about 17% of the nonelderly population (Kaiser Commission on Medicaid and the Uninsured, 2004). For the elderly, the federal Medicare system provides basic physician and hospital coverage. A limited prescription-drug benefit is being introduced. Medicaid, a program for the poor, faces severe cutbacks in eligibility and services because of costs. Despite calls for universal health coverage from prestigious organizations such as the National Academy of Sciences, it is unlikely to appear in the foreseeable future (Pear, 2004). Patients with private insurance are nearly twice as likely as are those with Medicaid to be offered follow-up clinic appointments within a week after emergency department visits; the implications for epilepsy care are striking (Asplin et al., 2005).

Some minority groups, such as Hispanics, American Indians, and African Americans, tend to be overrepresented among people in poverty. In 2004, 34% of Hispanics were uninsured, and 21% of blacks, compared with 11% of whites (Center for the Evaluative Clinical Sciences, 1998). Even when patients have insurance, high "copayments" may lead to reduced medication compliance for patients with chronic diseases (Newacheck et al., 1998; Goldman et al., 2004).

In an Epilepsy Foundation survey, 90% of U.S. epilepsy survey respondents were taking AEDs: 56% were receiving monotherapy; 26% were taking two; 6%, three; and 2%, four drugs. Only 68% of respondents were "very satisfied" with their current medications. Seizure control and side effects (particularly cognition and energy level) were the most important therapeutic issues, and drug cost was relatively less important. Eighty percent were "satisfied" with their medical care; 82% had health insurance coverage; 94% had seen a neurologist. Respondents had received less education, were less likely to be employed or married, and came from lower-income households than did the overall U.S. population (Fisher et al., 2000b).

Insurance companies, including the prescription drug plans approved by Medicare, may require "prior authorization" for prescriptions, a step approach, or "fail first" policies for use of AEDs, to limit use of high-cost drugs. Additionally, patient costs may vary widely among these drug plans, further limiting access. Some studies suggest that appropriate care has been compromised, particularly when the expensive drug has no or few alternatives (Soumerai, 2004). Others suggest, however, that HMO practices such as gate keeping, designed to reduce costs by limiting specialist access, may not have a clear negative impact (Ferris et al., 2001). In the United States, access to AEDs may be limited by cost. Although no specific data are available, this is likely to be an important issue for the ~15% of the population without health insurance at any given time. For patients with insurance and in HMOs, several factors may influence AED options. In a study of expensive new drugs in 53 organizations, etanercept and celecoxib were much more likely to be covered than were sildenafil and bupropion. Prior authorization, thought to encourage medically appropriate use, was more common for the former; coverage of sildenafil and buproprion was limited predominantly through generalized exclusion or restrictions on quantity or duration of use. Value judgments seemed more important than cost in coverage decisions (Titlow et al., 2000).

Increased use of generic drugs may affect care as well as reduce cost. Data from a California Medicare HMO whose coverage changed to a generic-only benefit showed reduced health plan pharmacy cost, increased out-of-pocket pharmacy costs for members, increased overall hospital admissions, and a negative impact on quality of care for several chronic disorders (Christian-Herman et al., 2004).

Native Americans, who may have higher epilepsy prevalence, confront barriers to care including geographic isolation, poor general living conditions (such as lack of telephones), lack of translation or interpretation services, distrust of caregivers, and traditional perspectives on epilepsy (i.e., a spiritual cause). A "persistent crisis" in Native American health is underlined by inadequate resources and high mortality compared with the United States as a whole (Roubideaux, 2005).

Illegal immigrants in the United States confront substantial barriers to medical care. Forty-seven percent of noncitizens, compared with 15% of citizens, did not have health insurance in 2005 (Capps et al., 2005). Patients may be unwilling to access physicians or emergency department care because of fear of legal consequences; even

when care is provided, local free health coverage programs are economically unsustainable over a long period without federal support (Hirota et al., 2006) Children from immigrant families had worse physical health than did children from nonimmigrant families and used care services at significantly lower frequency (Huang et al., 2006). Moreover, low levels of acculturation may be associated with higher family and personal stress, social alienation, and symptoms of depression (Miller et al., 2006).

A recent study found that 27% of all nonelderly women and 67% of uninsured women report they delayed or went without care they believed they needed in the past year because they could not afford it, compared with 24% and 59%, respectively, in 2001 (Kaiser Family Foundation, 2005).

The United States has one of the largest proportions of immigrants in its history, comparable to the years around 1900. Cultural barriers that are barely recognized by the medical community may affect access to, and efficacy of, medical care. A recent study suggested that resident physicians receive little training for, and are poorly prepared to deliver cross-cultural care (Weisman et al., 2005).

Inner city populations face limited finances and insurance, low education, and low expectations from patients by family members; and high use of alcohol and other drugs by caretakers. Children may have no adults to take them to appointments for a variety of reasons. Patients may have poor understanding of, and compliance with, instructions, leading to unnecessary seizure recurrences and emergency department visits. Patients visit multiple area health care facilities; care is often fragmented and suboptimal. Fewer private physicians exist in inner cities than in more prosperous areas. Fewer minority women seem to seek care for epilepsy. This may be due to fear of stigma, particularly perceptions about epilepsy in ethnic minority populations, in addition to the financial and social barriers facing all minority patients.

Disparities may exist in the surgical treatment of uncontrolled epilepsy. Seventy of 130 patients with temporal lobe epilepsy and mesial temporal sclerosis on MRI underwent surgery at University of Alabama Birmingham from July 1998 through January 2003 (Bureno et al., 2005). Multivariate logistic regression incorporating age, sex, income, insurance status, and education showed that African Americans were less likely to receive surgery compared with non-Hispanic whites (odds ratio, 0.4; 95% CI, 0.2–1.2). This finding, which could be related to referring physician practice patterns, surgery-center decisions, or even patient population cultural preferences, needs replication.

Hospitalization rates for epilepsy show regional and ethnic variation (National Center for Health Care Statistics, 2004). Epilepsy was the first-listed diagnosis for an estimated 466,000 hospitalizations; the age-adjusted hospitalization rate was 37 hospitalizations per 100,000. Rates were higher in men, patients older than 65, in Northeast (49/100,000) than in the South (37/100,000), North Central (35/100,000), and West (27/100,000), and substantially lower for whites (35/100,000) than for all other racial groups combined (51/100,000)—particularly older age groups. Thus during 1988–1992, ~93000 hospitalizations each year were attributed to epilepsy. Based on the estimated prevalence of self-reported epilepsy (50/100,000), an estimated 8% of PWE are hospitalized each year, including 25% 65 years or older (Jerath and Kimbell, 1981).

Care access appears lowest in the South (except Florida), and highest in New England, Minnesota, and Iowa (Fig. 3 and Table 8). For example, Massachusetts has among the lowest percentage of minority (13%), uninsured (9%), and rural (9%) residents and the highest per capita number of neurologists (11.9). Compared with Massachusetts, Louisiana has approximately twice the percentage of minority and uninsured residents, 3 times the percentage living rurally, but only half the per capita neurologists.

Accessibility, cost, prejudice, superstition, and lack of patient or primary care physician knowledge may limit

FIG. 2. Estimated people with epilepsy without medical insurance in the United States.

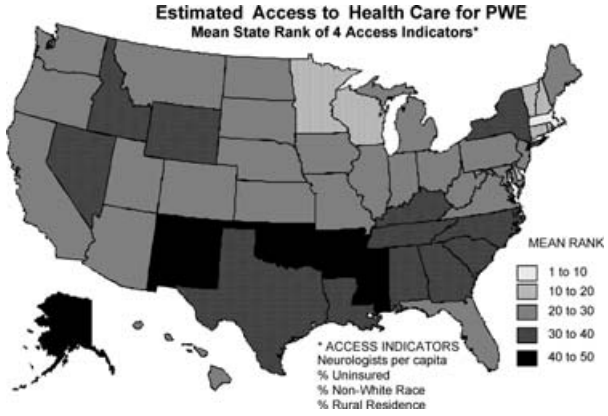

FIG. 3. Estimated access to health care for people with epilepsy, mean state rank of four access indicators.

TABLE 8. *Indicators of access to neurologic care, in the United States, by state*

State	Neurologists per 1,000 PWE	Rural Residence	Nonwhite	Uninsured (% Pop)	Uninsured PWE (n)
Alaska	3.2	34%	29%	18%	670
Alabama	5.4	45%	29%	13%	3,472
Arkansas	4.4	47%	19%	16%	2,507
Arizona	5.8	12%	12%	17%	5,300
California	5.8	6%	22%	19%	38,148
Colorado	5.0	16%	10%	15%	3,972
Connecticut	7.5	12%	15%	10%	2,088
Delaware	7.2	20%	24%	10%	448
Florida	7.3	11%	19%	18%	16,850
Georgia	5.3	28%	33%	16%	7,753
Hawaii	6.3	9%	74%	10%	706
Iowa	4.8	39%	5%	9%	1,511
Idaho	4.5	34%	5%	16%	1,279
Illinois	6.2	12%	21%	14%	10,374
Indiana	5.8	29%	11%	12%	4,386
Kansas	4.7	29%	11%	11%	1,761
Kentucky	4.7	44%	10%	13%	3,207
Louisiana	5.8	27%	36%	19%	4,988
Massachusetts	11.9	9%	13%	9%	3,436
Maryland	10.6	13%	37%	12%	4,271
Maine	5.9	60%	3%	11%	828
Michigan	5.3	25%	19%	10%	6,212
Minnesota	8.9	29%	10%	8%	2,368
Missouri	6.1	31%	15%	10%	3,498
Mississippi	4.4	51%	39%	16%	2,666
Montana	7.2	46%	9%	15%	824
North Carolina	5.8	40%	26%	15%	7,221
North Dakota	6.5	44%	7%	11%	412
Nebraska	5.0	30%	8%	10%	987
Nevada	4.8	8%	16%	18%	2,119
New Hampshire	7.0	41%	4%	9%	685
New Jersey	7.6	6%	23%	13%	6,628
New Mexico	4.4	25%	15%	22%	2,404
New York	9.0	13%	26%	16%	18,009
Ohio	5.4	23%	15%	11%	7,773
Oklahoma	3.7	35%	22%	18%	3,772
Oregon	6.4	21%	9%	13%	2,738
Pennsylvania	7.1	23%	14%	10%	7,150
Rhode Island	8.6	9%	11%	8%	523
South Carolina	4.9	40%	32%	12%	2,969
South Dakota	7.1	48%	11%	11%	481
Tennessee	5.6	36%	19%	11%	3,764
Texas	5.3	17%	16%	24%	30,293
Utah	4.9	12%	6%	14%	1,830
Virginia	6.4	27%	26%	12%	5,115
Vermont	7.9	62%	3%	10%	351
Washington	5.9	18%	14%	14%	4,823
Wisconsin	6.3	32%	10%	8%	2,708
West Virginia	5.6	54%	5%	14%	1,518
Wyoming	3.7	35%	5%	16%	486

use even of extensive resources to a small portion of PWE. Lack of insurance, particularly, may vitiate the effect of the apparently rich U.S. milieu, leading to outcomes comparable to those of less opulent environments. AAN estimates suggest some of the largest states have highest levels of uninsured PWE (Fig. 2). Lack of insurance may be particularly serious in epilepsy because of high AED costs.

Canada

The Canadian Health Care System provides coverage for most but not all (e.g., aesthetic surgery, in vitro fertilization) services. There is interprovincial reciprocity (except Quebec). Any MD can refer anywhere in Canada if services are not available locally, or if justified by complexity. Out-of-hospital allied services, optometrist, eye wear, dental care, and services requested for legal, driving, labor issues, as well as all specialists' consults require referral by GPs.

Most AEDs are available in Canada through direct purchase from pharmacies. However, coverage of different AEDs in drug-benefit plans vary by province, and new AEDs can take a long time to reach approved public insurance lists. Failure of a standard drug may be a requirement

for their use. Special application for unlisted drugs, laborious for physicians, has varying success. Prescription copayments have wide variability and may take income into account. A few groups pay nothing, including children, registered natives, and Inuits. Canada, however, has been successful at regulating drug prices, which are much cheaper than those in the United States.

ESC

In the period 2000–2002, 66 Caymanians with epilepsy had EEGs. Fifty-five patients had CTs, 15 had MRIs, and six had both. Almost all AEDS are available and in use; CBZ and PHT are the most common. Of identified 118 PWE, 112 were receiving AEDs; 74 patients were taking one; 32, two; five, three; and one, five drugs

In Jamaica, most adult epilepsy patients have a CT scan. Practitioners often refer to a neurologist only if the scan is negative, seizures not controlled or, increasingly, at the patient's request. Pediatric patients, however, are generally referred immediately to a pediatrician and frequently hence to the pediatric neurologist. Most AEDS are available, although newer drugs may not initially be available in the public hospitals.

Throughout the ESC, epilepsy care is financed through a patchwork comprising out-of-pocket, tax-based, social insurance, and private insurance, in every country, but the relative representation of these sources is likely to be quite different. Only Jamaica and Trinidad/Tobago lack disability programs for people with epilepsy. Of all the NAR nations, only Jamaica records a separate epilepsy component (5%) of the federal health budget.

COST TO SOCIETY

United States

The 1995 U.S. lifetime cost of epilepsy for incident and the annual cost of prevalent cases is estimated at $11.1 and $12.5 billion, respectively (Begley et al., 2000). The similarity of cost projections reflects steady-state assumptions build into the method for estimating lifetime costs, assuming mid-1990s medical technology, treatment patterns, relative medical resource value, and productivity effects of epilepsy (Hodgson, 1988). Innovations in medical technology will affect future direct and indirect costs, and thus their present value. Shifts in health resource utilization and changes in impairment-related productivity losses are impossible to predict accurately.

Epilepsy accounted for a small portion of the estimated $659 billion spent for all U.S. chronic diseases in 1990 (Hoffman et al., 1996). However, on a per-case basis, intractable seizures are costly. The average cost per patient for all chronic conditions was estimated at $7,355 in 1990, compared with the 1995 estimate of $9,939 for PWE. Epilepsy has a high percentage of indirect morbidity-related costs, 70% for intractable epilepsy compared with an average of 11% for all chronic disease, emphasizing the importance of seizure control in determining economic burden. Epilepsy strikes all ages, including the young, who are disabled during the most productive periods of their lives.

Indirect costs for the elderly are low because of shortened life expectancy, low labor-force participation rates, and low earnings. However, the older-than-65 population accounts for a disproportionate share of direct costs. The average per-person direct cost was $10,612, compared with $6,674 for persons aged 18–64, and $4,967 for children aged 0–17. Older people use more hospital care; a higher percentage continues AEDs. Given current projections for older-than-65 population growth, and problems with Medicare coverage, direct care costs for the elderly are a major concern.

RESEARCH

United States

The National Institutes of Health (NIH), the main U.S. biomedical research funding source, uses a grant coding system that is not fully reliable or consistent. Available numbers should be thought of only as rough guides.

From 1995 through 2002, NIH spending approximately doubled from $25 to $50 billion per year, whereas defense and "other" R&D increased only slightly (Regalado, 2004). However, NIH spending has remained flat since then, whereas increases in government R&D have been predominantly military.

Although disease spending and prevalence are only order-of-magnitude indicators, epilepsy seems relatively underfunded compared with other neurologic disorders (Table 9). Citizen's United for Research on Epilepsy (CURE) foundation data suggest that epilepsy received $38, Parkinson disease $230, and multiple sclerosis $248 in NIH funding yearly per patient in 2003. A study analyzing NIH funding found mortality, and disability-adjusted life years, but not incidence or prevalence predicted NIH funding (Gross et al., 1999). In this analysis, epilepsy was

TABLE 9. *NIH spending in millions of dollars for various diseases*

Disorder	Prevalence*	FY 2003 actual	FY 2004	FY 2005
Epilepsy	2,500,000	94	102	105
Asthma	15,000,000	248	272	289
Diabetes	18,500,000	910	996	1,055
Depression	13,000,000	288	302	329
Multiple sclerosis	450,000	99	101	110
Muscular dystrophy	20,000	39	39	40
Parkinson disease	1,000,000	230	224	229

*The figures given for prevalence are highly approximate. Source: http://www.nih.gov/news/fundingresearchareas.htm

underfunded, but to a lesser degree than other conditions such as depression.

A search of the NIH database for 2003 found ~560 grants related to seizures or epilepsy; ~50% were "human" or "clinical." There were 626 for Parkinson's disease and 330 for multiple sclerosis. Fellowships were 31, 45, and 13, respectively; and "program projects or centers," 71, 98, and 35. Again, these numbers should be used only as relative order-of-magnitude indicators.

In addition to NIH funding, The Centers for Disease Control were awarded $7.5 million in 1993 for support of the Living Well Conference objectives, including improving care and self-knowledge, combating stigma, epidemiology, and prevention, and increasing public awareness and knowledge (Centers for Disease Control and Prevention, 2006). In 2004 the Health Resources and Services Administration provided $2.9 million in grants to Improve Health Care for Children With Epilepsy, with the goals of improving access to ongoing care, addressing shortages in subspecialty care, identifying cultural and language barriers, and developing strategies for improving current systems of treatment (Health Resources and Services Administration, 2004).

Industry spending levels are hard to obtain. Drug companies may spend ~14% of sales on research each year; marketing is ≥60% of research costs (Barton and Emanuel, 2005). Data from Thompson Center Watch suggests that worldwide Pharmaceutical Research and Manufacturers of America member research will increase from $20 to $60 billion dollars over the period 1999–2007. Central nervous system investment increased from $4 to $14 billion, second only to cancer and endocrine disorders. Separate figures for epilepsy were not available (Steinbrook, 2005).

However, marketing and "physician education" components may be included in "research," particularly clinical drug development (Barton and Emanuel, 2005). Much of the basic research leading to industry drug development is performed in publicly funded academic or government laboratories that enter subsequently into cooperative development agreements with drug companies; public infrastructure may support substantial portions of the research costs claimed by industry, via insurance payments, and support of hospitals and physicians. Pharmaceutical pricing decisions, as with any industry, appear to be based on market forces rather than on costs (Keyhani et al., 2005). Other views underline the difficulty of recouping commercial investment and need for public–private partnerships in new drug development (McKinnell, 2004).

Industry seems to be devoting less attention to epilepsy than to other conditions. According to the Pharmaceutical Manufacturers' Association, 11 new drugs were said to be in development in 2003, but this includes topiramate (TPM) and oxcarbazepine (OXC). Two other compounds, pregabalin (PGB; recently introduced) and valprocemide are related to current AEDS. In contrast, 18 drugs are being developed for Parkinson's disease, 12 for multiple sclerosis and 28 for brain tumors.

Industry sets its priorities on the basis of anticipated profit, a perception influenced by the publicity given to various conditions. The FDA drug-review process is designed primarily to be "fail safe"; the institutional cost of approving an unsafe drug appears greater than that of failing to approve a useful one. The FDA does appear to be strongly influenced by advocacy groups and media coverage, at least in the rate at which drugs gain approval (Carpenter, 2004).

Voluntary research support comes from several sources. In 2003, the Epilepsy Foundation of America had ~$2,000,000 in grants; the American Epilepsy Society, $700,000; and CURE, $200,000. Several smaller groups exist, such as the Epilepsy Project. For comparison, the National Parkinson's Foundation spends about $4,000,000, and the Multiple Sclerosis Society, $30,000,000.

The number of active epilepsy investigators is uncertain. About 45% of 2800 AES members and meeting attendees describe themselves as "adult epileptologists," 28%, pediatric epileptologists, and 5%, neurosurgeons. It is interesting that only 13% of members, but 21% of meeting attendees (~2800 as well), describe themselves as "basic scientists." This suggests that the pool of researchers may be broader than otherwise measured.

The pace of epilepsy publication does not seem to have changed recently. By using the PubMed search criteria "epilepsy or seizures," "English," and "clinical trials," there were 908 hits from January 1, 1995, through December 31, 1999; and 878 from January 1, 2000, to December 31, 2004. In the same periods, there were 589 and 716 for "Parkinson Disease," and 403 and 539 for "Multiple Sclerosis."

In the 6 months from January 1, 2004, a search for "epilepsy or seizures," "English," and "human" (all publication types) returned 1724 hits, and 519 for "animal" studies, suggesting a preponderance of clinical publications.

The available data, although limited, suggest that epilepsy research funding is stable at a level lower than justified by disease impact. A substantial proportion of clinical studies appear to be supported by industry. The limited support available for research into care delivery and disparities has come mainly from CDC and HRSA, rather than the NIH.

Canada

Canadian Institutes for Health Research (CIHR) awards mentioning epilepsy increased over the last 5 years, although the majority are marginally related basic science. Ten were related to clinical aspects of epilepsy (total expenditure, $1,243,712), two to randomized trials (total,

TABLE 10. *CIHR epilepsy-related grants and awards, last 5 years*

Year	Grants	Total CND $	Number of awards	Total CND $
2004–2005	111	$9147,000	32	$1128,726
2003–2004	89	$8447,500	33	$1145,583
2002–2003	88	$7467,900	35	$1127,939
2001–2002	81	$6699,000	38	$1246,521
2000–2001	65	$4651,400	25	$844,746

CIHR, Canadian Institutes for Health Research. Source: www.cihrirsc.gc.ca/e/826.html

$354,618), and two related to social/cultural/population health (total $164,403). CIHR funded eight grants ($312,548) for collaborative research with the United States in the last 6 years (Table 10).

Epilepsy Canada, one of two specific, epilepsy-targeted research funding agencies in Canada, provides two to three $CDN38000 fellowships per year. The Savoy Foundation is an epilepsy-targeted research agency with small grant opportunities. Provincial Research Agencies rarely fund epilepsy projects. One of the largest, the Alberta Heritage Foundation for Medical Research (http://www.ahfmr.ab.ca/), with total funding of $CDN1.87M over 2 years, listed no directly epilepsy-related funding during the last 3 years. Other granting agencies fund research broadly but not specifically in epilepsy, and some focus on their own provinces. Examples include the Physicians' Services Incorporated Foundation of Ontario, the Medical Services Incorporated Foundation (Alberta), The Children's Hospital Foundation (Alberta), and the Toronto Sick Children's Hospital

Industry-initiated and funded research support is small. The Canadian Epilepsy Consortium, mandated to organize pharmaceutical trials, has none at present.

CONCLUSIONS

Epilepsy and the "health care crisis"

The problems of epilepsy must be considered in the context of the emerging health care crisis. U.S. health care spending, 16.0% of the gross domestic product (GDP) in 2004, is projected to reach $4.0 trillion and 20.0% of the GDP by 2015 (U.S. Centers for Medicare and Medicaid Services, 2006).

Public media interest in medical "advances" reinforces their desirability and marketability. In many cities, medical centers are architectural features and sources of civic pride comparable to late 19th century railroad stations and medieval cathedrals.

Unfortunately, increased spending does not lead necessarily to improved care. Data from a 2005 survey of patients suggested greater U.S. inefficiencies, errors, and access/cost barriers than in Australia, Canada, Germany, New Zealand, or the United Kingdom (Schoen et al., 2005). The United States lags other OECD countries on indicators of health such as life expectancy and infant mortality (Regalado A, 2004). In comparison with the United Kingdom, a country that devotes one of the lowest proportions of GDP in the OECD to health care, self-reported illnesses and biologic markers of disease show U.S. residents to be less healthy at all levels of socioeconomic status (Banks et al., 2006).

In the United States, a major problem is how to provide care at affordable cost to patients without insurance and equal access to groups (even if insured) facing rural isolation, urban "ghettoization," or other social factors. Moreover, trends toward "high deductible" health care plans, although saving money, may well reduce the use of effective preventive care, particularly for low-income patients (Lee et al., 2005).

The number of U.S. uninsured is estimated to have increased from 40 to 45 million over the last 4 years. Moreover, the proportion of physicians providing "charity" care has decreased from 76% in 1996–1997 to 68% in 2004–2005, possibly because of financial pressures and changing practice arrangements (Cunningham et al., 2006).

Increasing demand for services, as well as the inexorably aging population, may lead to unsustainable medical expenditures. In 2005, the United States had 0.20 inhabitants older than 65 years for every one from 20 to 64 years; by 2050, the ratio will double (Population Reference Bureau, 2005). In effect, every family of two working adults will be supporting an extra dependent. The Congressional Budget Office's most likely scenarios project that Social Security and Medicare costs alone will total ~13% of the GDP by 2030 (Congressional Budget Office, 2005). Cost estimates for the limited Medicare prescription benefit recently enacted have grown dramatically. Other economic trends, such as increasing company use of temporary workers who receive no benefits and shedding of pension and retiree medical care obligations by bankrupt corporations, will add additional public costs.

The United States is simply the most advanced example of this process; the sustainability of the Canadian health care model is a topic of current controversy. Spending is currently at 9.8% of GNP; interestingly, drug costs are increasing much faster than hospital and physician payments (Canadian Health Coalition, 2004). In Canada, access is (theoretically) universal, but attempts to control cost lead to resource rationing and long delays for procedures such as temporal lobectomy.

ESC countries face more-severe resource limitation, larger numbers unable to pay for services, and are too small (except Jamaica) to provide advanced diagnostic and treatment procedures by themselves. All countries share common problems of stigma against people with epilepsy, varying only in degree, and leading to restrictions

TABLE 11. *Directions for future research and improved epilepsy care*

A. Basic and clinical research
1. Neurobiology of epilepsy and AED mechanisms
2. AEDs, surgery, comorbidities
B. Primary prevention research; epidemiology and surveillance
C. Translation-to-care research
1. Quality of care, including intervention trials
2. Disparities
3. Access
4. Health policy research and advocacy
D. Stigma
1. Public knowledge of epilepsy
2. Legal and employment issues
E. Industry relations
1. Conflict of interest
2. Ethical collaboration
F. Government and regional relations
1. Cross-country/intraregional education/training: professional, patient, public
2. Development of collaborative regional facilities
3. Collaborative regional clinical research

in opportunity and reduced quality of life. Eventually even "middle income" countries like Jamaica will face the increasing costs of caring for the elderly.

Challenges for the epilepsy community

The objectives of the epilepsy community are to provide affordable, high-quality, evidence-based care to all PWE, to reduce the stigma against epilepsy, to improve the quality of life, and to promote research leading to improved treatment, and eventually, cure. What are the barriers blocking these goals?

Problems and approaches

In addition to our review, recommendations for enhanced efforts in several directions emerged from the 2003 EFA/AES/CDC/NIH conference (Living Well with Epilepsy II 2004), and the "Cure" Conference, sponsored by NIH, AES, EF, CURE, and the National Association of Epilepsy Centers in 2000 (Jacobs et al., 2001) (Table 11).

Basic and clinical research

Emerging neuroscience research, including genetics and molecular biology, not yet exploited fully, have enormous implications for epilepsy. In addition, the relatively weak links between basic neurobiology of epilepsy, studies in animal models, and clinical research must be strengthened.

We need new clinical research to provide guidelines for cost-effective therapies, including appropriate AED use in the primary care setting, optimal evaluation of patients for epilepsy surgery, and selection for brain stimulation. Recent experience with American Academy of Neurology guidelines for use of "new" AEDs suggests, however, that the paucity of available data makes clear conclusions difficult (French et al., 2004). New funding mechanisms for AED trials must be developed to support studies that industry does not have financial incentives to undertake.

Problems of special populations, such as children and the elderly, including AED pharmacology and comorbidities, would benefit from additional study. Of the 3.2 million PWE in NAR, 40% are women of childbearing age. Additional clinical research must address special problems of women with epilepsy, including hormonal seizure exacerbation, increased seizure risk during pregnancy, miscarriage, epilepsy and developmental delay in children, AED-related risk of malformation, anomalies, and neonatal hemorrhage.

Primary prevention, epidemiology, and surveillance

Our knowledge of NAR epilepsy epidemiology is limited. It is clearly time to repeat the large-scale Rochester studies, extended across NAR, with common diagnostic criteria.

The infrastructure developed for surveillance and epidemiologic studies should include attention to include etiology, new-onset epilepsy, and ascertainment of varying levels of seizure control across the population of PWE, as well as comorbidities and mortality.

The variegated etiologies of epilepsy suggest that primary prevention strategies might most effectively concentrate on specific issues such as reducing head injury from traffic and sports accidents. However, additional research must be done on the role of potential etiologies such as infection (Donati et al., 2003).

"Translation to care," access, and disparities

Several recent studies have shown that many patients in the United States with chronic diseases do not receive optimal care. Mathematical models suggest that new drugs with enhanced efficacy achieve significantly fewer improvements in health than does delivery of current drugs to all patients (Woolf et al., 2005). Improved access to care may reduce morbidity and mortality, particularly for groups such as African American children and the elderly (Woolf et al., 2004). "Implementation research" includes development and testing of models for delivering evidence-based care to community populations with chronic diseases (Rubenstein et al., 2006).

Research on translation of clinical trial evidence to community settings is needed to complete the process of population health from societal investment in basic research. Obstacles to translation of scientific advances into clinical implementation were identified by the Clinical Research Roundtable of the Institute of Medicine as occurring at two major "chokepoints": basic to clinical research, and implementation of clinical research findings in community settings (Sung et al., 2003). It will be important to increase research study participants, eliminate conflicts of interest as far as possible, and increase diversity of participation and community involvement. Development of uniform standards and practices for clinical research,

including privacy issues, will be an important component of increasing participation (Sung et al., 2003). Broadening clinical research opportunities in ESC countries may be an effective strategy not only for fostering regional integration, but also for improving patient care and professional and patient education.

Emphasis on patient self-management education may lead to improved quality of care and reduced costs and is one component of the chronic care model (Bodenheimer et al., 2002). Such approaches have been shown to be helpful in patients with diabetes, asthma, and arthritis. The ketogenic diet is an example of self-management already in place for patients with epilepsy.

Some diseases like diabetes or chronic obstructive pulmonary disease are strongly affected by factors such as diet, weight, and exercise, or smoking and air pollution, requiring active intervention by patients to modify their life-styles. Physician advice may support this process and has been shown to lead to reduced dietary fat intake, increased exercise, and improved health-related quality of life after stroke (Greenlund et al., 2002). Research on the outcomes of behavioral interventions for seizure control is limited, but clinical practice suggests that life-style modifications and behavior changes may also benefit people with seizures. Unfortunately, these outcomes may require intensive sustained individual approaches (Knowler et al., 2002). Both lack of reimbursement for self-management education and the "medical model" of chronic illness must be modified (Bodenheimer et al., 2002).

Educating physicians on the issue's importance as a societal goal is the first step toward increased minority participation in clinical research (Stark et al., 2002). Special efforts are needed to recruit minority investigators. Increased use of nursing and other ancillary personnel, linking with community leaders, addressing cultural issues and beliefs with sensitivity, and ensuring comprehensible consent forms may be helpful. Other approaches include providing childcare and transportation for study participants (Snodgrass et al., 2001).

Epilepsy knowledge is deficient, even among neurologists. Increasing professional education efforts should be made in all NAR countries. In the United States and Canada, more attention to primary care provider education is needed, including nurse-practitioners and similar professionals, who may provide much of HMO epilepsy treatment. In developing countries, ancillary personnel and primary care physicians should be targeted. Fellowships at advanced centers could develop expertise at several levels, with more emphasis on widespread community outreach, in appropriate circumstances, than on complex issues like surgical evaluation.

The community must address guidelines for epilepsy centers, particularly where surgery is to be performed. Members of the U.S. National Association of Epilepsy Centers vary widely in their facilities and staffing. The American Academy of Neurology is moving toward epilepsy subspecialty certification. Efforts will be needed to ensure that neurologists from smaller NAR countries can obtain certification, enabling them to serve as leaders and standard-setters in their own communities.

More than two thirds of Americans, and essentially all Canadians, receive their medical care through some form of managed care. Rather than confrontation, cooperative "ethically based" approaches may facilitate optimal care by using a "patient-centered" rather than "provider-centered" viewpoint to identify specific barriers to care (Randel et al., 2001). A recent report, Managing Epilepsy Care (Crowley, 2003), provides access to guidance and advocacy strategies for PWE, advocates, federal and state policymakers, and managed care program administrators. It suggests avenues for consumers to work with state Medicare and Medicaid agencies for epilepsy representation.

The epilepsy community must support insurance coverage for all procedures involved in patient evaluation, including necessary video-EEG monitoring, imaging, and neuropsychological and psychiatric services. The establishment of clear, unbiased treatment guidelines will be invaluable in the credibility of this process, particularly for new AEDs. Patients should have access to all available drugs, but it may be reasonable to work with insurance plans to create decision trees that limit use to patients who will derive benefit from them. Remaining legal impediments to the lives of PWE should be addressed throughout the region.

The role of economic and social factors in limiting access to epilepsy care and in creating disparities in NAR must be studied, in parallel with epidemiologic research. Few data exist on health disparities in epilepsy outcomes and health-related quality of life (HRQOL). Social and ethnic effects on epilepsy causes, incidence, prevalence, and outcome require further research. It will be crucial, in future studies, to collect data on socioeconomic status and care access, across NAR. "Racial" and "ethnic" identification may have a greater impact on all aspects of life, including health, as social constructs, than do biologic markers.

The availability of and access to resources to define, recognize, and treat the mental health, cognitive, and social complications of epilepsy are essential components of management for all NAR PWE.

Stigma

Stigma continues to be an important factor in the lives of many NAR PWE. Moreover, it is itself a cause of disease, increasing exposure to health risks and reducing access to treatment (Jacoby et al., 2005). Although some aspects of stigma may have declined in the United States, epilepsy evokes greater adverse responses even than other deeply stigmatizing diseases such as acquired immunodeficiency syndrome (AIDS) and mental illness (Jacoby et al., 2005).

We need to know more about stigma across NAR. Additional research is needed to determine how often felt and enacted stigma lead to epilepsy concealment and lack of treatment. Does this phenomenon vary across different NAR cultures (Jacoby et al., 2004)? What are the social structural and power elements leading to stigma?

Both research and approaches to stigma amelioration must be sensitive to differing regional sociocultural contexts. Patients with good seizure control in more-developed countries may still experience high levels of felt stigma, whereas those in less-developed countries may experience greater enacted stigma (Jacoby et al., 2004). Some but not all studies have suggested a significant relation between stigma and seizure control, as well as for psychopathology. Medical side effects may be a factor for both felt and enacted stigma (for example, if PWE appear "drunk.")

Law has an important role in changing social attitudes, particularly in diverse societies such as the United States and Canada. However, antidiscrimination law might partially increase stigma by reinforcing "differentness." Current U.S. law, although forbidding discrimination against people with disabilities who can do a job with no more than minimal accommodation, can be read as allowing discrimination against those who need substantial aid (Burris, 2006).

The Centers for Disease Control and Prevention (Shorvon, 2001) developed a tool to evaluate stigma about epilepsy in the general population, which may help fulfill critical gaps in understanding interpersonal and institutional stigma in the United States. Recognition of the extent of the problem is the essential first step in management.

Industry relations

Increasing reports of relationships between physicians involved in clinical trials and investors raise ethical as well as legal issues (Steinbrook, 2005). One recent example involved an AED (Lenzer, 2004). Current policies are unlikely to protect public and patient interests, and some authors suggest changes in continuing medical education programs, speakers' bureaus, and consulting and research contracts, particularly at academic medical centers (Brennan et al., 2006).

To achieve our goals, the relation of the epilepsy community to industry must evolve. Given increasing public resistance to high drug prices, recent reports of serious medication side effects, and general suspicion of pharmaceutical company motives, epilepsy community credibility depends on a clear perception of independence. Studies of new agents and devices, and the wider research agendas, have to be controlled by investigators, not by industry. Academic clinical epilepsy research needs particularly independent support. AES in particular must work with the NIH to achieve this goal.

Existing guidelines for ethical behavior are unlikely to have much effect on industry influence (Brennan et al., 2006). It is vital that new standards be developed for physician and scientist relations with industry, including research support as well as marketing to health care professionals. Educational programs must be independent and unbiased, throughout the region. It will be vital to ensure as well that new regulations, while protecting research from commercial influence, and promoting public confidence, will not stifle fruitful academic–industry collaboration (Stossel, 2005). Additional support may be needed to achieve these goals in the region's developing countries.

Another reason to reassess the relationship is the relative paucity of true therapeutic advances, in the face of a large number of "me too" compounds. Between 1998 and 2002, of 415 new drugs approved by the FDA, only 133 were "new molecular entities," and only 58 were considered by the FDA likely to be a "significant improvement" over existing agents (Barton and Emanuel, 2004, 2005); perhaps only 20% of drugs over past 10 years are qualitative advances (Steinbrook, 2005).

Industry-sponsored AED clinical trials usually focus on initial safety and efficacy studies, whereas "secondary" issues such as monotherapy, or head-to-head comparisons, important for devising optimal and cost-effective care strategies, may require government funding, at least in the United States (Privitera, 2006). Innovative partnerships may be needed to ensure a full range of AED studies. Moreover, some groups, such as children, or those with rare epilepsy syndromes, can be ignored by the system (Trevathan, 2003). A cooperatively funded pediatric epilepsy consortium, similar to the successful Children's Oncology Group (COG) may be needed to develop AEDs for children, as well as to refine their pediatric use.

Governmental and regional relations

The community must reach out to underserved areas and populations throughout the region more effectively to reduce disparities in care. The effort should include lay education programs and involvement of community groups. Increasing awareness of the problem of epilepsy at this level should also help to obtain more public and private funding for epilepsy research.

Advocacy can also be carried out at governmental levels in the smaller countries of the region, where the economic advantages of treating epilepsy can be stressed, particularly when cost-effective strategies are offered.

Within the United States and Canada, more interaction with state and provincial health departments may help promote awareness and treatment of epilepsy at the primary-care level. A recent CDC report suggested that state health departments have the expertise and resources to increase their current low level of involvement in epilepsy and other chronic conditions. Potential areas included assessment, epidemiology, and surveillance (Chronic Disease

Directors, 2003). School nurses can also play an important role in reducing stigma and facilitating a normal life for children with epilepsy. The epilepsy community could assist with efforts to make sure their epilepsy training and knowledge is appropriate. Health departments can also provide important assistance in epidemiologic studies, case surveillance and ascertainment, and evaluation of interventions devoted to prevention (such as head injury) and early treatment.

It will be very valuable to collaborate with the psychiatric community in developing regions. Patients with epilepsy and psychiatric disorders share problems of chronic disease, stigma, and lifelong treatment. Psychiatric and neurologic disorders are within the same WHO program group. According to WHO, 20% of children and adolescents worldwide have a disabling "mental illness" (World Health Organization, 2003). In developing countries, epilepsy often is recognized only when a child is referred to a psychiatrist. Racial and ethnic disparities in pediatric depression care, even after accounting for insurance, almost certainly apply to epilepsy as well (Richardson et al., 2003).

Interactions between the developed and developing countries may have fruitful educational benefits for all. Funds should be provided for residents and fellows from developing countries to obtain epilepsy fellowship training in the United States and Canada. Visiting teaching and lecture programs in the region could be supported. There may be important opportunities for collaborative research projects to study causes of epilepsy, such as cysticercosis, with an increasing regional impact. The problems of epilepsy care in a country such as Jamaica might provide important insights into how to approach underserved U.S. and Canadian populations.

TABLE 12. *Regional integration and resource sharing*

A. Encourage ILAE and IBE chapter formation in English-speaking Caribbean
E. Hold international epilepsy conferences in the English-speaking Caribbean
B. Develop country support for local education initiatives
1. Develop electronic and written teaching aids
2. Support program of visiting experts/teachers
B. Devise systems to facilitate training and certification of ESC epilepsy care personnel
C. Assist efforts to reduce stigma, improve quality of life
1. Restrictive rules on driving in developing countries
2. Help remove barriers to employment
D. Develop funded regional referral systems
1. Local ESC referral center for video-EEG monitoring and straightforward surgery
2. More-complex cases referred to U.S. or Canada
F. Involve the smaller NAR countries in research
1. Epidemiologic
2. Genetic
3. Clinical trials
B. Work with WFN /WHO (particularly PAHO in the Americas) on regional initiatives
1. Collaboration with Latin America

A REGIONAL EPILEPSY PLAN

U.S. "National action plans" exist for a number of conditions, including arthritis (Arthritis Foundation, 1999), heart disease (National Center for Chronic Disease Prevention and Health Promotion, 2005), and diabetes (U.S. Department of Health and Human Services, 2004). These serve to focus attention on problems and may help to elicit government and private funding. In Jamaica, increasing recognition of the public-health impact of preventable diseases, especially trauma, which in isolation is the single greatest cost to the annual health budget, has led to development of a "National Policy for the Promotion of Healthy Lifestyle in Jamaica."

Developed with interaction from provincial, national, and local governments, scientific and voluntary societies, and international bodies, the success of an Epilepsy Plan for North America will depend on regional integration and resource sharing, beginning with initiatives requiring fewer resources (Table 12). One example is provided by the effort in Jamaica to initiate presurgical evaluation for epilepsy and create a focus for development of epilepsy surgery in the Caribbean. It is perhaps relevant that a common "Caricom" (Caribbean Community Countries) passport for English-speaking Caribbean (ESC) countries (excluding the Cayman Islands, a British Overseas Territory) is being developed.

Improved seizure control must be the main target for the epilepsy community's efforts. All secondary QOL goals, including mental health, employment, and education, depend in great part on seizure control. The Cure conference established the long-term goal for PWE as no seizures, no side effects. To achieve the ambitious goal, not only of curing or preventing epilepsy for a fortunate few, but of bringing treatment to all, resources will have to be shared and international collaboration strengthened.

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