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Cost of epilepsy in Hong Kong: experience from a regional hospital

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To study the economic implications of epilepsy in Hong Kong, a cost-of-illness study was performed on a retrospective cohort of medically treated patients from a regional hospital. A societal perspective was examined. Utilization data from 1992 to 1996 were reviewed to obtain the direct costs. Lost productivity was used as a proxy for estimating the indirect costs. Future cost projected over 10 years was derived by incorporating model parameters. Of 745 records reviewed, total direct costs added up to USD 0.98 million and indirect costs to USD 1.32 million. Regarding the overall direct costs, hospitalization was the most consumptive item among patients with a shorter history of epilepsy and those with suboptimal seizure control. The mean total cost per patient increased steadily from 1992 to 1996 except for those with long-standing remission, and was highest in patients with medically refractory epilepsy in terms of both the actual value and rate of increment. Parameters with the most leverage on future cost would be unemployment rate and annual discount rate. The overall economy of the society would exert a major effect on the future cost of epilepsy, in particular, for patients with poorly controlled disease.

Key words: epilepsy; cost-of-illness; cost of epilepsy; Hong Kong; China.

INTRODUCTION

The International League Against Epilepsy Commission on Economic Aspects of Epilepsy (ICEE) was founded following the 20th International Epilepsy Congress, at which the socioeconomic issues of epilepsy from various nations were addressed[1]. The report of the ICEE workshop, published in 1996, highlighted the importance of economic impacts from epilepsy and research into this area[2]. The scarcity of health-care resources has also encouraged the appraisal of economic consequences from various health problems and services. Socioeconomic impacts of epilepsy[3–7] and the treatment options[8,9] have been intensively studied in many Western countries, but data from Hong Kong and China are still lacking.

The incidence and prevalence of epilepsy in urban China is 35 per 100 000 per annum and 4.4 per 1000, respectively[10]. The population of Hong Kong is 6.5 million. We estimate that 28 600 people are suffering from epilepsy and the number of new cases per year is 2300. Our unit provides acute admissions and secondary care for adult epileptic patients from the Central, Western, and Southern districts of Hong Kong Island, which consists of an urban population of approximately 0.5 million. We offer open access to the general public and services are largely free at the point of delivery. From our recent service data (unpublished), demands for both inpatient and outpatient services in epilepsy are growing by about 10% per year. In 1996, there were about 500 episodes of admissions and 3000 outpatient consultations for epilepsy, which accounted for approximately one-third of the overall neurology service. Expenditure on antiepileptic drugs (AEDs) has almost doubled over the 3 years from 1994 to 1996. However, epilepsy surgery is still being under-utilized with only 15 surgical procedures performed between 1994 and 1996.

The purpose of this study is to explore and elucidate the socioeconomic weights of epilepsy that are of local relevance.

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MATERIALS AND METHODS

A retrospective cost-of-illness study from a cohort of adult patients followed up at the Epilepsy Clinic and under medical treatment in 1996 was performed. Excluded from the analysis were patients: (1) with a single seizure and not on AEDs; (2) in remission not requiring AEDs; (3) who had undergone epilepsy surgery; (4) with psychogenic seizures or uncertain diagnosis of epilepsy; (5) with less than 1 year of follow-up by the end of 1996; and (6) in AED trials. Utilization data from 1992 to 1996 of the target population were collected from their clinical records. The initial valuation of cost items was in Hong Kong currency, which is constantly pegged to that of the United States at a rate of HKD 7.75 to USD 1.0.

The patients were divided into five prognostic groups according to their seizure frequency, treatment response, and natural history of illness (Table 1). Patients with initial suboptimal seizure control but who later achieved remission with conventional AEDs, i.e. phenytoin, carbamazepine, valproic acid, phenobarbitone, primidone, and benzodiazepines, were allocated into either Group 1 or 2. Patients with medically refractory epilepsy (MRE) given adjunctive AEDs, i.e. vigabatrin, gabapentin, and lamotrigine, and who achieved intermediate seizure control or remission were still classified as Group 4. For patients who were seizure free for 2 to 3 years, AEDs would be gradually discontinued if this was socially and psychologically acceptable to them.

Avoidable costs attributable to epilepsy in Groups 1 to 4 were estimated from a societal perspective. For Group 5 patients, epilepsy was an associated disorder and the majority of avoidable expenditures were due to their primary neurological disorders.

Direct costs

Direct costs are the resources directly related to the organization and provision of services. The net direct costs were estimated by synthesizing secondary and model data, which included expenditures on: (1) hospitalization; (2) outpatient service; (3) AEDs; and (4) therapeutic drug monitoring (TDM) at the clinic.

Our hospital was under contract terms with the Hospital Authority (HA) so that a fixed sum of monetary subsidy per patient would be paid for each day of hospitalization regardless of the amount of resources utilized in that particular admission. In addition, the patients had to pay a fixed fee of about 5% of the subsidy. The cost of each admission was calculated as the product of the number of days of inpatient care and the amount of subsidy plus the patient's payment at the time of hospitalization. Only the admissions for acute management of epilepsy or complications arising from epileptic seizures or its treatment were costed. Admissions for epilepsy surgery or pre-surgical evaluations were not included. The cost of TDM was estimated similarly. The hospital was paid a fixed subsidy for each TDM test performed. The total cost of TDM for each patient was calculated as the product of the number of tests carried out and the amount of subsidy at the time of testing. TDM would be performed when poor drug compliance or AED toxicity was suspected, following a breakthrough seizure, during pregnancy, and in difficult cases to determine the optimal dosage of AEDs. TDM was not performed routinely on patients with good seizure control without clinical evidence of AED toxicity.

A shadow market price was used to reflect the cost of outpatient service. The fees for neurology consultation from specialist clinics attached to private hospitals were obtained through a survey and a mean value was calculated. A 20% capacity cost and 30% cost-to-charge difference (i.e. profit) were deducted from this value to give the cost of each visit to our outpatient clinic.

The hospital dispensary provided all the AEDs at no additional charge to the patients. To estimate the expenditure on AEDs, each record was reviewed manually to obtain the amount of drugs prescribed from 1992 to 1996 inclusively. Drug costs were calculated as the product of the number of tablets prescribed and the purchasing price of each tablet at the time of prescription.

The cost for investigations was not included. Work-up for new patients, including blood tests, computerized tomography scan, and electroencephalogy, were usually performed during the initial admission so that their costs could be absorbed into that of hospitalization. Expenses on pre-surgical evaluation, such as magnetic resonance imaging, single photon emission computed tomography scan, video-telemetry, and intra-arterial amobarbital test were also not included since the analysis was restricted to the cost information from medically treated patients.

Indirect costs

Indirect costs are related to the consequences of the illness rather than to the specific delivery of medical care. All indirect expenditures were valued at their opportunity costs, and lost productivity was used as a proxy for estimating opportunity costs. There were two sources of lost productivity from epilepsy—morbidity and mortality. The former would result in partial loss of productivity while the latter in total loss. The estimation of indirect costs was based on a prognostic model in which corresponding group-specific

Table 1: (Left) Prognostic groups of the target population. (Right) Excessive unemployment rates and excessive mortality (age and sex specific) attributable to epilepsy, and their duration after onset of illness for prognostic Groups 1 to 4.

		Unemployment and mortality in excess of the national rate			
		Unemployment	Duration	Mortality	Duration
Group 1	Patients in remission, <7 years history of epilepsy — 'Early remission'	2×	2 years	none	—
Group 2	Patients in remission, long-standing history — 'Long-term remission'	2×	4 years	none	—
Group 3	Patients with intermediate seizure control	2.5×	lifetime	1.2×	10 years
Group 4	Medically refractory epilepsy with >1 seizure/month	4×	lifetime	4×	lifetime
Group 5	Patients disabled from neurological diseases other than chronic epilepsy or had major developmental abnormalities				

mortality rates and lost productivity were defined[3] (Table 1). (Begley *et al.*[3] included in their model a sixth prognostic group—patients with difficult seizure control initially but later achieved remission. Because of the retrospective nature of the present study, they could be allocated into either Group 1 or 2, and were not classified separately.) The age- and sex-specific life expectancy, unemployment rate, and median annual income of the Hong Kong population from 1992 to 1996 were incorporated into this model. The cost of lost productivity during the study period for each patient per year was obtained by multiplying the product of the overall population unemployment rate and the group-specific excessive unemployment with the median annual income of the corresponding year.

Estimating the future costs

Future costs were estimated by incorporating model data. Estimation was restricted to a projected period of 10 years to avoid significant deviations from the model parameters and assumptions, even though epilepsy may be a life-long disease. The rate of inflation in direct costs was deduced from the mean composite consumer price index (CCPI) of Hong Kong from 1992 to 1996, which was 8.5% per year. The mean increment rate in median income and unemployment rate from the same period, which were 8.7% per year and 2.5%, respectively, were applied in deducing the indirect costs. Time preference was adjusted with an annual discount rate of 4%. The natural history of epilepsy and likelihood of AED withdrawal in Group 1 patients were predicted from the results of the Medical Research Council Antiepileptic Drug Withdrawal Study[11] (Appendix 1). Declining exponential approximation was applied to determine the length of survival for each patient[12, 13]. The mortality rate of each patient was the product of the reciprocal of the corresponding average age- and sex-adjusted life expectancy of the whole population and his/her group-specific excessive mortality. The reciprocal of that figure would be his/her approximate length of survival. The total projected costs for each patient would be the cumulative sum over 5 or 10 years of the direct costs for the expected duration of requiring medical treatment and the indirect costs for the expected duration with productivity loses. Indirect costs from mortality would be included if premature death was expected within the projected time frame. Direct costs would be absent after death.

Univariate sensitivity analyses to allow for parameter uncertainties were performed. The variables and their ranges used for analysis were as follows: (1) CCPI: 6.3 to 9.6%; (2) unemployment rate: 1.9 to 3.5%; (3) annual increment rate of the median income: 6.4 to 10.2%; (4) annual discount rate: 0 to 8%[14]; and (5) the lower to upper end of the 95% confidence interval of the mean total costs at 1996. The ranges of the first three variables were derived from their corresponding minimal and maximal figures between 1992 and 1996.

RESULTS

Of the 745 patients reviewed, 388 patients (52.0%) were in remission while on AEDs, in whom 302 (40.5%) were in long-term remission and 86 (11.5%) were in early remission, 92 (12.4%) had MRE, and 186 (25.0%) were in the intermediate group. The remaining 79 patients (10.6%) belonged to the last group with disabling neurological diseases or major degree of developmental abnormalities.

Overall costs from 1992 to 1996

From 1992 to 1996, the overall direct costs of all groups added up to USD 0.98 M and indirect costs to USD 1.32 M. Direct and indirect costs accounted for 42.7% and 57.3% of the total expenditure, respectively (Table 2). The total indirect costs were higher than direct costs in all prognostic groups except for those in long-term remission.

Table 2: Total direct and indirect costs, in thousands of USD, and proportions of direct and indirect costs in the overall expenditure for prognostic Groups 1 to 4 and all four groups from 1992 to 1996.

		All groups	Group 1	Group 2	Group 3	Group 4
Total direct costs	92–96	982.8	84.6	285.8	317.1	295.3
Total indirect costs	92–96	1320.7	121.7	18.3	685.6	495.1
Direct : Indirect costs		42.7 : 57.3	41.0 : 59.0	94.0 : 6.0	31.6 : 68.4	37.4 : 62.6

Regarding the direct costs of all the groups, 23.8% of the overall amount was spent on drugs, 39.0% on outpatient service, 35.3% on hospitalization, and 1.9% on TDM. This proportion for each prognostic group is summarized in Table 3. For patients in remission (Groups 1 and 2), the overall AED cost was less than 20% of the total direct costs. These patients also required admission for the following reasons: (1) seizures related to poor drug compliance, (2) seizures due to suboptimal AED treatment, and (3) withdrawal seizures. The overall expenditure in hospitalization for patients with early disease was almost double that of those with long-standing epilepsy. On the other hand, over half of the total direct costs were used to cover outpatient expenses of patients in long-term remission. For patients with MRE and intermediate seizure control (Groups 3 and 4), a higher proportion of the total direct costs was spent on drugs, in particular, patients with MRE in whom overall AED cost was almost 10% higher than that for the other groups. However, hospitalization was still the most consumptive item among these patients, as well as for those in early remission.

Average annual costs

The mean total cost per patient with MRE, intermediate seizure control, early remission, and long-term remission were USD 1.30 K, 0.77 K, 0.45 K, and 0.24 K in 1992, and 2.60 K, 1.56 K, 0.80 K, and 0.23 K in 1996, respectively. The values between 1992 and 1996 are shown in Fig. 1. The mean total cost per patient, except those in long-term remission, increased steadily from 1992 to 1996. (The peak in 1995 was due to high indirect costs from an unemployment rate of 3.5%.) The rate of increase in mean total cost per patient was different for each group and was highest for patients with MRE, but remained almost unchanged for those in long-term remission.

To account for the differential increments of mean total cost in various prognostic groups, an analysis of the breakdown of cost items and their trends was carried out. The respective mean cost per person for hospitalization, outpatient visit, AEDs, and indirect costs for patients with MRE were USD 0.15 K, 0.14 K, 0.13 K, and 0.86 K in 1992, and 0.23 K, 0.24 K, 0.36 K, and 1.76 K in 1996, respectively. The mean AED cost and indirect costs per person for those with intermediate seizure control also increased from USD 0.06 K and 0.55 K, to 0.12 K and 1.10 K, respectively. The respective mean costs per person on hospitalization, outpatient visit, and AEDs for patients in early remission were USD 0.10 K, 0.13 K, and 0.02 K in 1992, and 0.11 K, 0.14 K, and 0.06 K in 1996, while those for patients in long-term remission remained similar throughout the period.

Future costs, 1997 to 2006

The projected total costs (adjusted to the 1996 value) per patient with MRE, intermediate seizure control, early remission, and long-term remission over 5 and 10 years would be USD 13.64 K and 40.04 K, 8.05 K and 18.00 K, 1.73 K and 3.39 K, and 1.31 K and 2.93 K, respectively (Fig. 2).

Results of sensitivity analyses are summarized in Table 4. Variations of future projected costs were largest for patients with MRE and least for those in remission. Parameters with the most leverage on projected costs, in particular, for patients with MRE, were unemployment rate and annual discount rate.

DISCUSSION

The present report is one of the very few economic studies on epilepsy performed in Southeast Asia and the first in a Chinese population. Indirect costs accounted for about 60% of the total resource consumption. Regarding the overall direct costs, hospitalization was the most consumptive item in patients with a shorter history and those with suboptimal seizure control. The mean total cost per patient, except for those with long-standing remission, increased steadily from 1992 to 1996, and was highest for patients with MRE in terms of both the actual value and rate of increment. Parameters with the highest impact on future cost would be unemployment rate and annual discount rate, in particular, for patients with poorly controlled disease.

Table 3: Breakdown of items in direct costs, in thousands of USD, and percentage of total direct costs for prognostic Groups 1 to 4 and all four groups from 1992 to 1996.

Cost of:	Hospitalization	Outpatient	AED	TDM
All groups	347.0	382.9	233.9	18.9
Proportion of total direct cost	35.3%	39.0%	23.8%	1.9%
Group 1	36.2	33.8	12.7	1.9
	42.8%	40.0%	15.0%	2.2%
Group 2	69.4	160.2	55.4	0.9
	24.3%	56.0%	19.4%	0.3%
Group 3	120.7	113.3	70.6	12.5
	38.1%	35.7%	22.3%	3.9%
Group 4	120.8	75.7	95.2	3.7
	40.9%	25.6%	32.2%	1.3%

(AED, antiepileptic drug; TDM, therapeutic drug monitoring.)

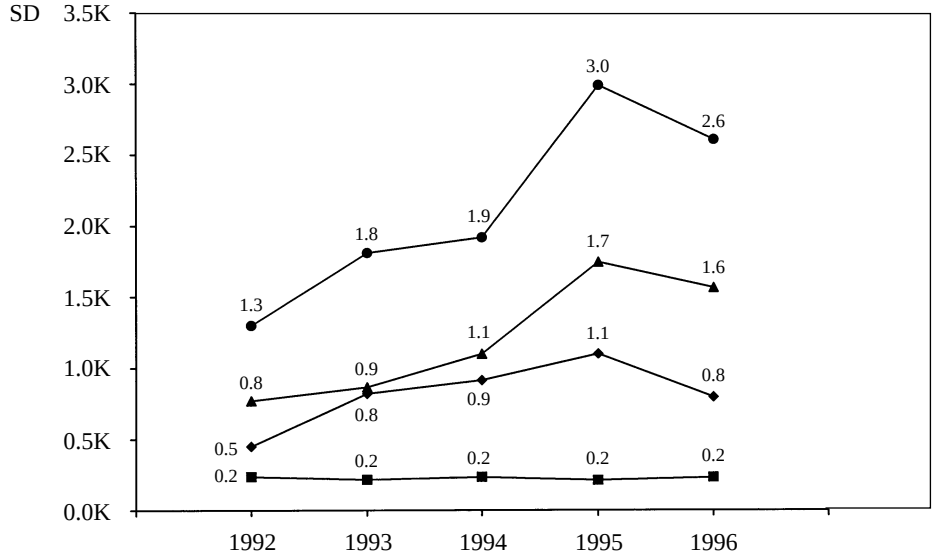

Fig. 1: Mean total cost, in thousands of USD, per patient per year for prognostic Groups 1 to 4 from 1992 to 1996. (— —, Group 1; — —, Group 2; —▲—, Group 3; —●—, Group 4.)

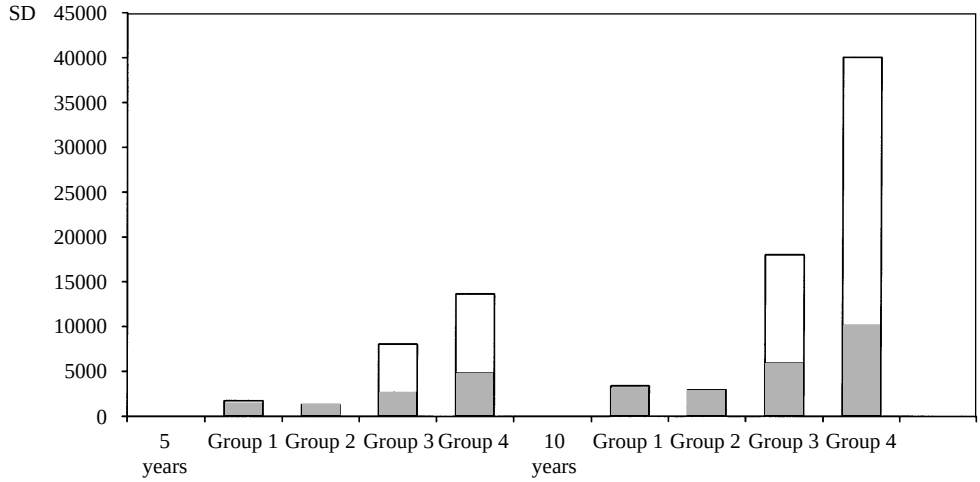

Fig. 2: Direct and indirect components of the projected costs, in USD, of each prognostic group over 5 and 10 years. (□, Indirect costs; ■, direct costs.)

Table 4: Univariate sensitivity analyses of the projected costs, in thousands of USD, over 5 and 10 years of each prognostic group (adjusted to the 1996 value).

Projected total cost over:		5 years				10 years			
		Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4
Baseline		1.73	1.31	8.05	13.64	3.39	2.93	18.00	40.04
CCPI	6.3%	1.65	1.23	7.89	13.35	3.05	2.60	17.34	38.08
	9.6%	1.78	1.35	8.13	13.79	3.58	3.11	18.36	40.64
Unemployment rate	1.9%	1.66	1.31	6.75	11.57	3.32	2.93	15.10	37.28
	3.5%	1.86	1.31	10.2	17.09	3.52	2.93	22.83	48.93
Income increment/year	6.4%	1.73	1.31	7.71	13.09	3.38	2.93	16.65	37.63
	10.4%	1.74	1.31	8.32	14.08	3.40	2.93	19.23	45.19
Annual discount rate	8%	1.57	1.17	7.17	12.15	2.79	2.36	14.56	31.42
	0%	1.93	1.48	9.09	15.43	4.21	3.71	22.87	52.36
95% CI of mean	lower	1.41	1.15	7.51	12.74	2.68	2.57	16.79	38.14
	upper	2.07	1.47	8.60	14.54	4.10	3.30	19.25	41.94

(CCPI, composite consumer price index; CI, confidence interval.)

Selection of the target population

The target population of the present analysis was selected from a hospital-based clinic rather than from a primary care population. In Hong Kong, 70% of primary care is provided by private sector physicians on a free-for-service basis, while the HA provides over 90% of specialist care[15], which is almost fully subsidized so that patients' out-of-pocket payment is minimal. Shared care of epilepsy between specialists and primary care physicians is not properly structured, and epileptic patients can rarely afford private health-care because of the chronicity of their illness and inadequate insurance cover. Unlike the United Kingdom[16] and United States[17] where primary care physicians have a major role in epilepsy management, patients in Hong Kong are almost solely cared for by hospital clinics even for non-refractory cases. Because of this unusual setting, data of the present study incorporated both community- and hospital-based populations. This also explains why a large number of our patients were in remission.

The target population was categorized into five prognostic groups according to their disease severity and response to treatment, which would determine an individual's cost-of-illness (COI). This group-specific effect on resource consumption was also expressed by some[3, 18] but not all studies[5, 7]. Nevertheless, considerable heterogeneity may still exist within individual prognostic groups, in particular, Group 3.

Approach in valuing inputs

When real data are inadequate or absent, the use of consumption models is accepted as a valid, and often necessary, form of scientific inquiry for economic analyses[19]. However, their use is often subjected to controversies since information applied for making inferences are derived from diverse sources of varying qualities. The ICEE report stated that there is no consensus on a universally applicable method of economic study in epilepsy[2]. A few consumption models can be used for deriving inputs in the evaluation of economic burden and cost effectiveness of interventional options. The most widely used approach is by gross costing (assigning an average value to each patient for a particular event) on model data[3, 4, 6–9, 20, 21]. Other less commonly applied methods include micro-costing (directly enumerating every input of a particular patient) on retrospective administrative or clinical data[18] and gross costing on primarily collected data[5].

The present study utilized a combination approach for cost evaluation—individual direct costs based on gross contract data (hospitalization and TDM), modified market price (outpatient), and micro-costing from retrospective clinical data (AED); and cost of unemployment based on average wages. Nevertheless, since local epidemiological literature and statistical records on illness-specific mortality and work-related indirect costs relevant to epilepsy were not available, we had to apply a United States model on the target population.

Approach in estimating indirect costs

We adopted a human capital approach in deriving the indirect costs, which assumes that an individual's worth to the society is equivalent to his/her productive output valued at a discounted market price. When a person's earning capacity is impaired, resources of the society have to be diverted towards supporting this unproductive member. Therefore, epilepsy will result in costs incurred by the society equivalent to, for the case of mortality, the projected lifetime loss of earnings of the deceased; and, for the case of morbidity, the reduced income due to unemployment and underemployment. Indirect costs are deduced by summing

the marginal change in wages of the affected individual. However, techniques based on this approach will under-estimate the indirect costs from individuals who do not generate an income, such as students, housewives, and children[22]. To overcome this problem, a unified value of lost productivity to calculate the opportunity costs of restricted activities for all patients was applied. People will take the consequences or benefits of their daily activities into account when allocating their time and energy, and choose to devote these resources to activities that would result in the greatest utility. Gains from activities other than working can be considered as trade-offs of the incomes generated by working, and opportunity costs of restricted activities from epilepsy was, therefore, assumed to value equally as the corresponding level of lost productivity.

Intangible cost due to impaired quality of life from epilepsy is increasingly recognized as an important component of the burden of illness. Measurement of disease-specific quality of life outcomes is now being recommended as an integral part of epilepsy research as well as clinical practice[23–25]. The ICEE also stressed the importance of humanitarian gains in addition to fiscal benefits in managing epilepsy[2]. The present analysis did not allow for the estimation of intangible cost because of its retrospective nature. A prospective longitudinal study will be appropriate for assessing its magnitude in the target population.

Consumption pattern in relation to disease severity

Previous studies indicated that patients with MRE utilize substantially more resources than those with better seizure control[3, 18]. Our findings were similar, which occurred during both the study and projected periods. On analyzing the cost components, the respective mean expenditures per person on AEDs and outpatient visits in patients with MRE were almost tripled and doubled during the study period. The mean cost per person on AEDs for patients with intermediate seizure control was also doubled. The cost increments were probably due to the introduction of expensive AEDs and more frequent clinical monitoring in these patients. Although there was no apparent economic benefit during the study period, the long-term changes in resource utilization are still uncertain. Moreover, our model is inadequate for determining the modification in indirect costs over both the study and projected periods. Another remarkable finding is that the mean expenditure per person on AEDs was almost tripled for those in early remission while that of other items remained similar throughout the study period. This is consistent with our changing prescription practice: sustained-release preparations of valproic acid and carbamazepine are preferred to phenytoin and phenobarbitone in treating newly diagnosed patients.

When compared with the figures from other cost-of-illness studies[26], our estimates for the cost per patient were much lower. Several factors might explain this discrepancy. The preferable use of generic formulations over brand-name AEDs, a strict policy for TDM, and possibly the relatively late introduction of adjunctive AEDs in our clinic might have lowered the direct costs. Moreover, our study design did not include the costs of epilepsy surgery and pre-surgical evaluations. The use of gross costing in valuing hospitalization might under-estimate the actual expenditure in some patients, for example those receiving intensive care for status epilepticus or major trauma from seizures. For the indirect costs, our method did not allow for the estimation of mortality-related lost productivity during the study period. In addition, there was no well-structured vocational policy for epileptic patients in Hong Kong so that their employability might be worse than their United States counterparts, and our model might under-estimate their unemployment rate.

Indirect costs of epilepsy

It is notable that indirect costs accounted for the majority of the total costs—an observation that was also demonstrated in other studies[3–6, 27]. The ratio of indirect to direct costs and the rate of increment of indirect costs were particularly high for patients with MRE and intermediate seizure control. Mean indirect costs per person for those with either MRE or intermediate seizure control were doubled in 1996 when compared with 1992. Sensitivity analyses indicated that unemployment rate and annual discount rate were parameters that would exert the most leverage on the future projected costs. These factors are dependent on the overall economy of the society and psychosocial functions of epileptic patients. There are two important implications of these findings.

Firstly, the recent financial crisis in Southeast Asia, which also affects Hong Kong profoundly, has resulted in an unfavourable economic and investment environment. Discount rate is determined by the stability of economic growth. It is foreseeable that returns on capital investments will be reduced in the coming few years so that the annual discount rate will be lowered or even be negative. Moreover, the unemployment rate of Hong Kong by the end of 1998 was 5.7%, which had already exceeded the sensitivity range applied in the analysis. In view of the adverse economic factors, a substantial increase in the indirect costs from epilepsy

is expected, in particular, for patients with more severe disease. In addition, epileptic patients might be more prone to unemployment than the general population at times of economic recession[28], so that the model input for epilepsy-related excessive unemployment would under-estimate their future lost productivity.

Secondly, strategies in managing epilepsy should focus on reversing the indirect costs in order to convert the invested resources into overall economic savings. Besides achieving seizure control, improving patients' psychosocial and functional status are also important considerations. Surgery for MRE was shown to improve the occupational outcomes in appropriate patients[29–32], so that long-term indirect costs can be reduced but at the expense of a substantial initial direct investment. The recent increase in our drug bill for AEDs was due to the use of more expensive sustained-release preparations as well as new AEDs. The effects of new adjunctive AEDs on occupational outcomes are not well defined but a positive modification of some quality of life domains was reported[33]. The funding of hospitals in Hong Kong is similar to the British National Health Service and the amount of services that can be provided is limited by a budget constraint. In order to meet the budget, the use of more expensive or labour-intensive interventions might have to be sacrificed for financial reasons. Nevertheless, it is not appropriate to deprive patients of these therapeutic options in order to contain cost, although the associated long-term reduction in indirect costs may not be immediately apparent.

CONCLUSIONS

The first economic analysis related to epilepsy in a Chinese population is presented. Patients with poorly controlled disease were shown to utilize substantially more resources than those who were seizure free, and a large proportion of the total consumption was from indirect costs. The overall economy of the society would also exert a major effect on the future cost of epilepsy. With the recent adverse economy of Hong Kong and the rest of Southeast Asia, the socioeconomic impact of epilepsy is expected to rise, in particular, for patients with intractable disease. Although our estimates and analyses may be of little relevance to nations other than Hong Kong, the present study may serve as an example of the applications of this information in the context of resource planning.

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APPENDIX 1: METHOD FOR PREDICTING THE LONG-TERM OUTCOME IN GROUP 1 PATIENTS

One thousand seven hundred and eighty-nine patients who were in remission for at least 2 years on AEDs were recruited to the Medical Research Council Antiepileptic Drug Withdrawal Study[11]. One thousand and thirteen of them were randomized with 510 patients allocated to the slow withdrawal group. Ten of them decided not to discontinue AEDs and another eight resumed AEDs despite being seizure free after withdrawal. By the end of 4.5 years, 373 patients were in remission without AEDs. Therefore, for those in whom withdrawal was attempted, 76% ($373 \div (510 - 18)$) remained seizure free at the end of the follow-up period. If all the 1013 patients were subjected to AED withdrawal, 977 patients ($1013 \times (510 - 18) \div 510$) would agree to comply. Among these patients, it is estimated that 741 ($977 \times 373 \div (510 - 18)$) were able to discontinue AEDs and remain in remission, which was 41% of the overall 1789 patients.

The chance of achieving remission without AEDs becomes smaller in those with a longer history of epilepsy and duration of AED treatment. The additional percentage of patients that can stop AEDs successfully per year will level off at around 5 years after commencing AED withdrawal. We assume that patients who remain seizure free for 2 years but cannot be or opt not to be taken off AEDs over the next 5 years will require long-term drug therapy. Fifty-nine percent of patients belong to this group, including 45% ($[776 + (1013 \times 18 \div 510)] \div (1013 + 776)$) in whom AED withdrawal is not attempted on the patients' or physicians' discretion, and 14% in whom AED discontinuation fails. For ease of calculation, we assume AEDs can be withdrawn from an equal number of patients from year three to year seven so that eventually 59% of patients will require long-term AEDs. Therefore, by the end of year three to year seven after onset, the expected probability to remain on treatment for a Group 1 patient will be 91%, 84%, 75%, 67%, and 59%, respectively. Afterwards, he or she will be categorized as a Group 2 patient.