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THE USE OF MENTAL HEALTH CARE FACILITIES AFTER STROKE

A Cost Analysis

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Abstract

Objectives: Although psychiatric comorbidity is relevant for a number of diseases, it is often ignored in technology assessment. This study examines the service use rate in mental healthcare facilities and related costs for stroke patients discharged from the University Hospital Maastricht between 1987 and 1995.
Methods: Through anonymous record linkage, the medical registration of the hospital and the registration of the Maastricht Mental Health Case Register were linked.
Results: Linkage succeeded for 16% of the 2,020 stroke patients, indicating that these patients used mental health services during a 10-year period around the stroke (±5 years). Of the users' group, 88% had a mental healthcare contact following stroke. Regression analysis shows that age, length of hospital stay, and mental healthcare contact before stroke are associated with mental healthcare use after stroke. It is remarkable in that there is already an increase in the consumption of mental health care in the prodromal phase just before the stroke occurred. When comparing costs before and after stroke, the outpatient costs increased on average by €42.64, semi-institutionalized costs increased on average by €208.10, and intramural costs by €1,189.21. The total increase in costs is €1,439.95. For all mental healthcare facilities, the increase in costs is significant.
Conclusions: No study so far has revealed the total costs of mental healthcare facilities following stroke. Extrapolating these costs to the Netherlands illustrates that stroke patients have a high psychiatric comorbidity, inducing about 1.3% of total mental healthcare costs.

Keywords: Costs and cost analysis, Comorbidity, Cerebrovascular disorders, Mental health care

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When looking at morbidity, mortality, and costs, the impact of stroke on society is relatively high. The World Health Organization (WHO) defines stroke as sudden signs of focal or global loss of neurological functions that last longer than 24 hours or cause death, with confirmed or suspected vascular origins (45). Stroke has a significant social and economic impact on patients, their families, third-party payers, and on society as a whole. In Western countries, about 2% to 4% of total healthcare costs are devoted to stroke (12). No study so far has revealed the total costs of psychiatric comorbidity following stroke (11). The only available information is that about 1% of the costs of stroke patients during their hospital stay can be assigned to the department of psychiatry (34).

However, medical outcome studies show that stroke is associated with psychiatric diseases. Mental problems encountered after stroke include affective disorders, dementia, anxiety disorders, and personality disorders. This study examines the use of mental health facilities and costs associated with stroke. A more profound analysis of the related stroke prevalence in psychiatric disorders and the patterns of mental healthcare consumption using the same set of data is published elsewhere (10). This article focuses on the economic aspect of psychiatric morbidity related to stroke. In addition, sociodemographic factors and length of hospital stay determinants for the use of mental health facilities by stroke patients are sought by looking at stroke diagnosis.

PSYCHIATRIC MORBIDITY RELATED TO STROKE

To gain insight into psychiatric morbidity related to stroke, a MEDLINE literature search from 1966 through 1999 was conducted, combining thesaurus "mental disorders" with "cerebrovascular disorders." In the literature, it is suggested that affective disorders, dementia, and anxiety disorders are encountered after stroke. Several studies also note a high percentage of coexistence between several psychiatric disorders related to stroke, especially between depression and anxiety disorders (3;4;5;37). It should be remarked, however, that most studies do not compare the results with control subjects. However, in the few studies in which such a comparison is made, a significant difference is found in psychiatric morbidity between the stroke population and the general population (18;21).

Depression

Despite the fact that the relationship between stroke and depression is frequently studied, findings are inconclusive (17;20). The prevalence of poststroke depression (PSD) found in various studies is widely variable (20). In the studies reviewed, the percentage varies from 14% (31) for major depression to 36% for all depressions (16). These differences can be explained by variations in the diagnostic criteria used, in the follow-up period (17), and in the characteristics of the study population. Furthermore, these figures may differ because neurologic signs in stroke patients may both mask and mimic depression, such as aphasia and emotional lability (20;27;33). This means that diagnosing PSD is difficult, especially for nonpsychiatrists, such as the neurologists and neurosurgeons who in most instances perform the medical checkups (13;35). For this reason, some investigators have suggested that PSD might be overdiagnosed due to changes in appetite, sleep, or sexual interest that are caused by stroke; others have suggested that PSD may be underdiagnosed because physicians may deny symptoms of depression (35). In addition, the relationship between stroke and depression might be reciprocal, since several studies found that a depressed mood is also associated with increased stroke morbidity and stroke mortality (24;25;36;38).

Other Affective Disorders

Next to PSD, emotional lability and manic disorders have been studied in relation to stroke. Emotional lability is a common emotional-behavioral syndrome following stroke and is

probably a separate condition from PSD (19;27). In a study that tried to determine the frequency of emotional lability following a first stroke, 18% of the patients had emotional lability (27). The occurrence of mania following stroke is another recent area of investigation (32). In comparison with depression, the occurrence of mania after stroke is relatively rare and is therefore illustrated only by case studies (2;40).

Dementia

In the literature (6;8;22;28;29;30;42;43), the frequency of dementia after stroke varies from 6% (29) to 32% (30). As with affective disorders, this variation can be explained by differences in the diagnostic criteria used, in the follow-up period, and in the study population. The study by Pohjasvaara et al. (29) was illustrative, showing that the frequency of dementia in one population could vary from 25.5% using the DSM-III criteria to 6.0% using the ICD-10 criteria. Diagnosis is further hampered because some clinical markers for dementia, such as disorientation, are also persistent following stroke (9). In addition, the occurrence of dementia may be overestimated, as in other psychiatric diagnoses, due to the fact that most studies rely on the diagnosis of dementia after stroke without measurement of prestroke cognitive function (21).

Anxiety Disorders

Threatening events such as stroke are likely to be associated with anxiety, and it is therefore expected that an increased incidence of anxiety disorders follow stroke. Study results (1;3;18;26;37;39) report a prevalence of generalized anxiety disorders (GAD) after stroke ranging from 3% (26) to 27% (5). GAD is long lasting, as no significant decrease is seen in studies during the 3-year follow-up (1).

METHODOLOGIC ASPECTS

In summary, the literature shows that there is a correlation between stroke and mental disorders. To study post-stroke mental healthcare consumption, we have phrased three research questions:

1. What are the extra costs of mental healthcare consumption after stroke, from the healthcare perspective?
2. To what extent can the difference between stroke patients who use mental health care after stroke and those who don't (AFTER vs. NONAFTER) be explained by such factors as mental healthcare use before stroke, stroke diagnosis (infarction, hemorrhage transient ischemic attack [TIA]), sociodemographic factors (age, gender, living together), length of hospital stay, and discharge destination?
3. To what extent may the difference between low-cost users and high-cost users (LOWAFTER and HIGHAFTER) of these mental health facilities be explained by such factors as mental healthcare use before stroke, stroke diagnosis (infarction, hemorrhage, TIA), sociodemographic factors (age, gender, living together), length of hospital stay, and discharge destination?

Data Source

For this study, the medical registration of the University Hospital Maastricht and the registration of the Mental Health Case Register were linked. Since 1981, the Maastricht Mental Health Care Register (MHCR) (14) has collected data cumulatively on all mental health contacts (the psychiatric hospital, the community mental health center, the psychiatric department of University Hospital, the community psychiatric outreach team, psychogeriatric nursing homes, sheltered housing, child psychiatric services, services for the mentally impaired, alcohol and drug abuse services, etc.) and demographic and diagnostic data in

a region with a population of around 200,000 (city of Maastricht: 120,000; surrounding areas: 80,000). For the current study, registered contacts with child psychiatric services, alcohol and drug abuse services (which are separate from the general psychiatric services in the Netherlands), and services for the mentally impaired were excluded. The University Hospital Maastricht is the only hospital in the city of Maastricht and the surrounding area with both a regional and a top-referral care function. In the University Hospital Maastricht, all patients are registered with an ICD-9 classification on discharge. Patients with an ICD-9 code of 430 to 438 have cerebrovascular diseases (7). All stroke patients discharged from the University Hospital between 1987 and 1995 are included in this study. If patients were admitted more than once, only the first admission was considered in the analysis.

Initially, 4,913 clinical patients with ICD-9 codes 430–438 were selected for the study from the hospital registration in the period from 1987 through 1995. Further inclusion in the study was based on the following criteria: patients coming from the Maastricht region, who did not die during their hospital stay (survivors), and who had a primary stroke diagnosis. This selection was necessary in order to obtain unpolluted data for our study. For example, insight into poststroke mental health care consumption is hampered if the patient comes from outside the Maastricht region (16.1%), dies during the hospital stay (20.4%), or if they have only a subsidiary stroke diagnosis (37.2%). Because of this, only 41% of the original hospital registration data set was used for the analysis. In total, 2,020 patients were eligible for the study.

Through anonymous record linkage, this group of 2,020 patients from the registration of the University Hospital Maastricht was linked with the registration of the MHCR. The Medical Ethics Board approved this data linkage. The linkage was based upon the first letter of the family (maiden) name, gender, date of birth, residence, and postcode of the general practitioner (identifiers). Experience from the MHCR and other studies showed that these identifiers give the best linkage, in which the chance of mistaken identity is minimal (41). The group for which the linkage succeeded were regarded as USERS of mental healthcare facilities; the remaining group was regarded as NONUSERS of mental healthcare facilities. For the last two research questions, only those users who had a mental healthcare contact within the 10-year reference period (5 years before and after the stroke) were analyzed.

Cost Analysis

In this study, only direct mental healthcare costs are considered, since no information is available regarding other costs. Direct healthcare costs include costs in terms of healthcare utilization. The quantities in this study derive from the MHCR. Prices used reflect mean costs, which are based on figures provided by the *Financial Statement of Care* (44). The *Financial Statement of Care* is a government publication that is presented to the Dutch Parliament together with the budget (44). It gives an integrated overview of financial developments in the healthcare sector during recent years in addition to predictions for the coming year. All cost data used refer to the year 1995. Based on this publication we calculated mean prices, which were checked by financial experts in several institutions. Overall the calculated mean prices matched the cost figures of these institutions; only the costs of the Community Mental Health Center differed from those reported in the *Financial Statement of Care*. Table 1 shows all-inclusive costs per unit in Euros (exchange rate 1 € = 2,20371 NLG [Dutch guilders], January 1, 1999), which were used in the study for the relevant mental healthcare facilities.

Variables

Neither of the registrations were specially devised for this study. As a result, only a limited number of variables were available. The variables included in this analysis are described below.

Table 1. Cost Prices for the Different Mental Healthcare Facilities

Category	Volume	Price[a]
Psychiatric hospital	Day	€157
Psychiatric department of a university hospital	Day	€193
Psychiatric department of a nursing home	Day	€126
Psychiatric day care	Contact	€106
Community mental health center	Visit	€71
Self-employed psychiatrists	Visit	€74
Outpatient visit psychiatric hospital	Visit	€52
Outpatient visit psychiatric department of a general hospital	Visit	€52

[a] 1 € = 2,20371 NLG, exchange rate January 1, 1999.

Dependent variable:

- Costs were measured using the MHCR registration. If patients contact an outpatient, semi-institutionalized (e.g., day care), or inpatient facility, their contact is registered. Using the procedures described in the paragraph on cost analysis, these data are transformed into costs.

Independent variables:

- Sociodemographic factors included age, gender, and living arrangements. Age refers to age (in years) at admission. Gender was coded 1 for female and 0 for male. We used the term "living arrangements" to distinguish between people who were living together and people who were living alone.
- Previous mental health care: the use of mental healthcare facilities before the stroke in cost prices was also measured for outpatient, semi-institutionalized, and inpatient facilities.
- Hospital factors: the diagnosis upon discharge from the hospital was measured using the ICD-9 classification. For further analysis, patients were divided into infarctions, hemorrhages, TIAs, and other strokes. Length of hospital stay refers to the number of days between admission and discharge, including both the admission day and the discharge day. Discharge status is described using several categories. These include home, homes for the elderly, other hospital, nursing home, rehabilitation center, psychiatric hospital, other institutions, died with or without autopsy, unknown, and went home against medical advice. As most stroke patients are discharged to a home situation, this variable was dichotomized into discharged to home and not discharged to home. The discharge specialist gives an indication of the discipline that is most closely related to the patient's treatment. In most instances this discipline is neurology, but this study also analyzed whether patients were discharged by a psychiatrist or by any other specialist.

Data Analysis

To explore the difference between the several subgroups, a *t* test was used for continuous variables, and for binary variables a Mann-Whitney test was employed. For the first research questions, it appeared that the differences in cost before and after the stroke are non-normally and asymmetrically distributed; therefore, the nonparametric SIGN test for two related samples was used. As is also noted in other studies (23), mental healthcare costs in this study are heavily skewed to the right due to a minority of stroke patients who account for the majority of the costs. However, applying the square root log-transformation of the costs did result in a normal distribution of the costs. In order to explain the difference between AFTER users and NONAFTER users (Research Question 2), and between HIGHAFTER users and LOWAFTER users (Research Question 3), the cost had to be dichotomized. A binary logistic regression analysis was used to answer these last two research questions. Categorical and ordinal variables were transformed into dummies. Variables were entered

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into a logistic regression analysis using backward stepwise selection, in which variables are removed from the model based on the probability of the likelihood statistics.

RESULTS

Subjects and Selection

A total of 2,020 primary stroke survivors from the Maastricht region are included in the study. Of this patient group, 18.7% (n = 377) had contact with the MHCR at any time, e.g., stroke patients for whom the linkage succeeded on the previously mentioned identifiers: the so-called USERS. The remainder of the group were regarded as NON-USERS.

The major part of this USERS group, 317 of 377, had contact within a 10-year reference period around the stroke (±5 years). As Figure 1 shows, 60% of this USERS group had a mental healthcare contact following stroke, 28% had contact before and after the stroke, and 12% had contact with the mental healthcare facility only before the stroke.

Mental Healthcare Consumption

Figure 2 shows that in comparing the 5 years before stroke hospital admission with the 5 years after stroke hospital admission, mental healthcare costs rise. When comparing the costs before and after stroke, the outpatient costs increase on an average by €42.64, the semi-institutionalized costs on an average by €208.10, and the intramural costs by €1,189.21. The total increase in costs is €1,439.95. For all mental healthcare facilities, the increase in costs is significant for outpatient care (standardized z value is −6.543, two-sided p value <.001), for semi-institutionalized care (z = −3.320 and p value <.001), for in-patient care (z = −5.700 and p value <.001), and for total care (z = −8.986 and p value <.001). This figure also illustrates that there is a shift toward more intensive care. It is remarkable that there is already an increase in mental healthcare consumption in the prodromal phase just before the stroke occurred. In comparison with the fifth year before the attack, the total costs increase two-and-a-half times to €150,46 in the last year before the stroke. In the first year following the stroke, the costs increase to €561.19, and these costs finally decrease to €223.37 in the 5-year follow-up period.

As a check, the costs of the mental healthcare episode of stroke patients are compared with the costs of the mental healthcare episode for nonstroke patients of the same average age. These data are also derived from the MHCR. A mental healthcare episode is a period in which a patient continuously consumes mental health care (limited by 90 or more days without mental health care). This comparison indicates that the episode costs of mental health care for stroke patients are significantly higher (€24,768) as compared to the mental healthcare episode costs for nonstroke patients, which on the average are €18,439.

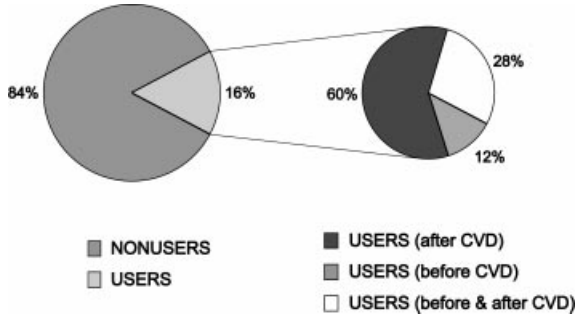

Figure 1. Users and nonusers of mental health care and moment of contact (n = 2,020). Abbreviation: CVD = cerebrovascular disease.

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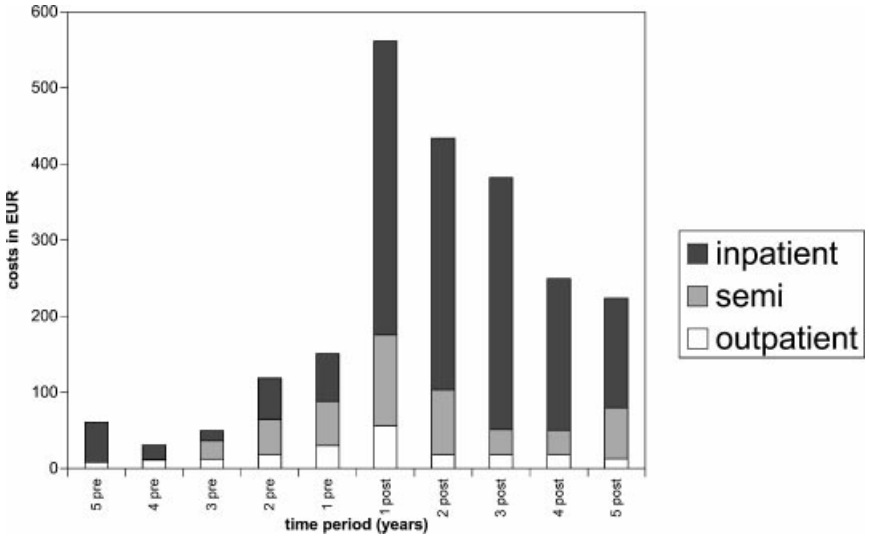

Figure 2. Average mental healthcare costs (EUR) for all stroke patients (n = 2,020). Note: Changes were tested by using a nonparametric SIGN test for two-related samples; outpatient, semi-instutionalized, and inpatient costs increased significantly.

AFTER and NONAFTER users

For further analysis of Research Question 2, both groups who used mental healthcare facilities after stroke (AFTER) are compared with the groups who did not use mental health facilities after stroke (NONAFTER), e.g., the nonusers and the only-before users.

Table 2 presents means and standard deviations for the characteristics for the several subgroups in our population. The average age of the study population was 71 years, and in general there was an equal distribution over the sexes. The AFTER users have a significantly higher age (2.7 years older) in comparison with the NONAFTER users. The patients included have a mean length of hospital stay of 24.3 days, which is comparable to the national figures for stroke. Of the total study group, 6.3% of the stroke patients had mental healthcare contact before their stroke; not surprisingly, this percentage is significantly higher (32.0%) in the AFTER users than in the NONAFTER users (2.2%). AFTER users had a significantly longer length of hospital stay (37 days) in comparison with NONAFTER users (22 days). The majority of patients can be categorized as having had a cerebral infarction. Stroke patients who used mental health care after their attack were more likely to be diagnosed as having a hemorrhage instead of an infarction. For most patients (55.1%), the department of neurology was responsible for treatment during their hospital stay; only a small percentage of patients were under the responsibility of a psychiatrist. However, if patients were discharged by a psychiatrist, they were more likely to consume mental health care after stroke, indicating that psychiatric comorbidity is already recognized in the hospital. On being discharged, four-fifths of the patients return to a home situation. In order to answer our first research question, variables were entered into a logistic regression analysis with AFTER users as the dependent variable.

Logistic regression results of the study population are presented in Table 3. Regarding Research Question 2, the main factors explaining the difference between stroke patients who use mental health care after stroke and those who don't, the explained variance is low ($R^2 = 0.23$). The current model gives a significantly better fit of the data, in which overall 88.9% of the patients are classified correctly; the correct classification is also relatively low (32%) for the AFTER group.

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Table 2. Exploratory Statistics of the Population

	Total group n = 2,020	NONAFTER n = 1,742	AFTER n = 278	*p* Value[a]	LOWAFTER n = 139	HIGHAFTER n = 139	*p* Value[a]
Age	71.1 (13.3)	70.7 (13.4)	73.4 (12.7)	.002[a]	70.9 (14.2)	75.8 (10.5)	.001[a]
Gender (% male)	50.5	51.0	47.5	.279	46.8	48.2	.811
Living together (%)	-	-	-	-	45.3	32.1	.028[a]
Mental health before (%)	6.3	2.2	32.0	<.001[a]	23.0	41.0	.001[a]
Length of hospital stay	24.3 (29.0)	22.2 (23.0)	37.2 (51.3)	<.001[a]	25.1 (27.5)	49.4 (65.1)	<.001[a]
Infarction (%)	24.2	25.1	18.3	.015[a]	18.7	18.0	.877
Hemorrhage (%)	14.6	13.9	18.3	.054	18.7	18.0	.877
TIA (%)	9.7	9.6	9.7	.972	10.8	8.6	.544
Other diagnoses (%)	51.6	51.3	53.6	.481	51.8	55.4	.548
Neurology (%)	55.1	56.0	49.6	.047[a]	52.5	46.8	.338
Psychiatrist (%)	1.0	0.5	4.3	<.001[a]	0.0	8.6	<.001[a]
Discharged to home (%)	80.5	81.0	77.7	.197	86.3	69.1	.001[a]

[a] Age and length of hospital stay; independent samples, *t* test; other independent samples, Mann-Whitney U test.

Table 3. Regression Results for AFTER Versus NONAFTER Users

	β	SE	p Value	Odds ratio
Discharged by psychiatrist	.974	.576	.091	2.649
Age	.015	.006	.010	1.016
Diagnosis infarction	−.528	.186	.005	0.590
Length of hospital stay	.009	.002	<.001	1.009
Mental care before	2.932	.216	<.001	18.760
Constant	−3.459	.445	<.001	
Goodness of fit				
Initial log-likelihood function	1,340.987			
Final log-likelihood function	1,345.207			
Model improvement (chi-squared)	273.324 ($p < .001$)			
R^2	.230			
Correct classification (%)				
Nonafter group	98.0			
After group	32.0			
Overall	88.9			

The odds ratios presented in Table 3 indicate the change in consumption of mental health care after stroke. Odds ratios above one enhance a positive relation between the variables and mental health care after stroke. Odds ratios less than one indicate a negative association; if the odds ratio equals one, there is no association between the variable and mental healthcare consumption. Not surprisingly, the main factor explaining whether patients have mental health care after stroke is if they already consumed mental health care before the stroke. Other factors indicating that stroke patients are more likely to consume mental health care are high age, a long hospital stay, and whether a psychiatrist discharges them. If a patient has an infarction as opposed to hemorrhage, he or she is less likely to consume mental health care after the stroke.

High-cost and Low-cost Users

In our final research question, high-cost users after stroke (HIGHAFTER) are compared to low cost users after stroke (LOWAFTER). The cut-off point (two equal groups, percentile 50) was total mental healthcare costs of €1,300 after the stroke.

Table 4. Regression Results for HIGHAFTER Versus LOWAFTER

	β	SE	p Value	Odds ratio
Discharged to home	.775	.338	.022	2.171
Discharged by psychiatrist	6.890	10.369	.506	982.397
Age	.029	.011	.010	1.029
Length of hospital stay	.006	.004	.091	1.006
Mental care before	.680	.295	.021	1.975
Constant	−.3.3235	.843	.001	
Goodness of fit				
Initial log-likelihood function	332.342			
Final log-likelihood function	335.777			
Model improvement (chi-squared)	49.613 ($p < .001$)			
R^2	.218			
Correct classification (%)				
Nonafter group	76.3			
After group	55.4			
Overall	65.8			

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Table 2 also gives the main characteristics of both groups, showing that high-cost users are older (by 4.9 years) and more likely to be living alone. As might be expected, the HIGHAFTER group were more likely to have consumed mental health care before their stroke. Also, the length of hospital stay is longer than for the LOWAFTER group. Furthermore, high-cost users were likely to be discharged by a psychiatrist and less likely to be discharged to a home situation.

The explained variance of the model differentiating between high and low costs is low at 22%. The strongest relationships statistically emerge with respect to patients discharged to a home situation (as opposed to being discharged to an institution), high age, a long hospital stay, and the use of mental health care before the stroke.

Although the logistic regression analysis showed some improvement, the correct classification (76.3%) in this model is even lower than in the previous research question.

DISCUSSION

This study was initiated as a result of a cost-of-illness study showing that little information was available regarding the use of mental healthcare facilities following stroke (11). In accordance with the literature, this study illustrates that there is a correlation between stroke and mental disorders. The most important result of the present study, however, is that it is the first to give an impression of the additional mental healthcare costs following stroke. Psychiatric comorbidity is thus a relevant problem in stroke, although it is usually ignored in economic evaluation studies.

In our study, about 16% of survivors admitted to hospital with a diagnosis of primary stroke had a mental healthcare contact within the reference period of 10 years ($\pm$5 years of attack). Of this group, about 88% had a mental health contact following the stroke. Outpatient, semi-institutionalized, as well as inpatient mental healthcare costs increased significantly after the stroke. In the 5 years following the stroke compared with the 5 years before the stroke, the costs increase on an average of €1,440 for all stroke patients in our study. It is striking that there is already an increase in mental healthcare consumption in the prodromal phase just before the stroke occurred. This might possibly be explained by the fact that stroke patients may have had a less serious stroke or TIA before being hospitalized. In addition, the average mental healthcare episode costs for stroke patients are significantly higher as compared with mental healthcare episode costs for nonstroke patients. This might indicate that stroke patients not only consume more mental health care but also more intensive mental health care.

Extrapolating this cost figure of €1,440 to the Dutch situation indicates that mental health after stroke is a relevant problem. In the Netherlands, the annual incidence of stroke is estimated at 174 of 100,000, of which 83% are first strokes, e.g., 145 of 100,000 (15). In the period of 1987 through 1994, on the average 27,069 stroke patients are discharged (including those who die) from the hospital. For the extrapolation it is assumed that 83% of these patients have had first strokes; i.e., this would result in 22,558 stroke patients per year. On average, 81% of this group survives the hospital stay, resulting in 18,272 first-stroke patients who survive the hospital. If the average costs and the admission rates remain stable, this would result in about €26.31 million extra costs related to stroke. In 1995, the total mental healthcare budget was €1,962.69 million. The extra costs per year for stroke, limited to those patients who are hospitalized and survive, would thus amount to 1.3% of the annual mental healthcare budget in the Netherlands in 1995.

Based on the variables of the study, it is difficult to explain the variance between patients who use mental health care after stroke and those who do not and between the high-cost and the low-cost users. Current data illustrate that older stroke patients who live alone and who had a mental healthcare history before the stroke are at risk for mental healthcare

consumption after stroke; this last correlation is also illustrated in other studies (23). The finding that stroke patients with high mental healthcare costs after the stroke are more likely to have been discharged by a psychiatrist illustrates that the psychiatric comorbidity is already recognized in the hospital. The longer length of hospital stay for those who use mental health care after stroke might indicate problems related to blocked beds; i.e., stroke patients may stay relatively long in the general hospital due to nonmedical reasons, such as having to wait for a place in mental healthcare facilities. Further research on this subject, but with a more extensive database, is needed, particularly since our data analysis lacks an indication of the psychiatric diagnoses.

The results of this study are based on a probability record linkage of two prospectively collected data sources. Both linkage and data analysis are based on conservative assumptions. However, it should be noted that this study may suffer from some methodologic limitations. The study is based on secondary data analysis. The two data sources used are the medical registration of the University Hospital Maastricht and data of the Mental Health Care Register, which recruit patients from the same limited area. Due to regulations, the data of both registers had to be anonymous. Linkage was based upon the first letter of the family (maiden) name, gender, date of birth, residence, and postcode of the general practitioner (identifiers). Although this linkage may be criticized, former research of the MHCR showed that these identifiers give the best linkage, in which the chances of misidentification are minimal (41). Furthermore, the assumption underlying this study is that there is a causal relation between stroke and mental healthcare problems. One of the main limitations of the current design of this study is that it is impossible to give enough evidence for this relationship. Although the literature suggests a logical chain from stroke to mental health care, this does not rule out the possibility of a common cause for both stroke and mental health care (for instance, advanced age), or even a reciprocal relation, since many patients had a history of mental care close to or even before the stroke. Further research in this field is needed. In addition, due to practical considerations, the calculation of cost per unit is limited to the *Financial Statement of Care* as a cost source. Also, this study is limited to mental healthcare costs, leaving out other aspects related to psychiatric comorbidity and stroke. In addition, no attention has been paid to other possible comorbidities in relation to stroke.

Meanwhile, we believe that these limitations do not invalidate the conclusion that can be drawn from the current results, indicating that stroke patients have a high psychiatric comorbidity related to additional costs in the mental healthcare sector.

POLICY IMPLICATIONS

In economic evaluation studies, the cost of comorbidity is often ignored, even though this information can provide important insights into the cost of a certain illness, leading to well-informed policy decisions, or to the adoption or rejection of new health technologies. The present paper investigates the costs of psychiatric comorbidity in Dutch society. The findings may not be easily generalizable to other societies, since the organizing system in the Netherlands may vary from that in other countries. Furthermore, due to the design, this study is limited to psychiatric comorbidity related to stroke. Nevertheless, the knowledge gained from this study, in conjunction with the literature, is that psychiatric comorbidity is a very common as well as a forceful, limiting problem for surviving stroke patients, leading to additional resource consumption in all countries. Economic evaluators should therefore be encouraged to consider the costs of relevant comorbidities in all future analysis.

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