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COST ANALYSIS OF STROKE CASES ADMITTED TO OUR EMERGENCY DEPARTMENT IN TÜRKIYE

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Abstract

Objective: It was aimed to investigate and costs of stroke patients.

Materials and methods: A database of stroke patients admitted between November 15th, 2016, and November 15th, 2017.was constructed. Descriptive statistics were used to summarize cost and patients' demographics. Mann-Witney U test was used in the analysis of nonparametric data. A value of $p<0.05$ was considered statistically significant

Results: A total of 91 patients were analyzed, the median age was 79 (12) years.

The median cost for ischemic stroke patients included in our study was $573.78 [$1307.75], while for hemorrhagic stroke patients, it was $1161.69 [$2128]. We found a statistically significant difference in costs between stroke types ($p<0.05$). The cost of hemorrhagic stroke to our hospital was higher.

Conclusions: According to our study, we found that the median cost of patients was $859.66. We also observed that gender and comorbidities did not affect the cost.

Keywords: *Emergency, stroke, cost.*

Резюме

АНАЛИЗ ЗАТРАТ НА ЛЕЧЕНИЕ ПАЦИЕНТОВ С ИНСУЛЬТОМ, ПОСТУПИВШИХ В НАШЕ ОТДЕЛЕНИЕ НЕОТЛОЖНОЙ ПОМОЩИ В ТУРЦИИ

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Цель. Исследование направлено на изучение стоимости лечения пациентов с инсультом.

Материалы и методы. Создана база данных пациентов с инсультом, принятая в период с 15 ноября 2016 года по 15 ноября 2017 года. Описательная статистика использовалась для обобщения расходов и демографических данных пациентов. При анализе непараметрических данных использовался U-тест Манна-Уитни. Значение $p<0,05$ считалось статистически значимым.

Результаты. Обследован 91 пациент, средний возраст 79 (12) лет. Средняя стоимость лечения пациентов с ишемическим инсультом, включенных в наше исследование, составила 573,78 доллара США [1307,75 доллара США], а для пациентов с геморрагическим инсультом - 1161,69 доллара США [2128 долларов США]. Мы обнаружили статистически значимую разницу в затратах между типами инсультов ($p<0,05$). Стоимость лечения геморрагического инсульта для нашей больницы была высокой.

Выводы. Согласно результатам исследования, средняя стоимость лечения пациентов составила 859,66 долларов США. Он также обнаружил, что пол и сопутствующие заболевания не влияют на стоимость лечения.

Ключевые слова: *неотложная помощь, инсульт, стоимость.*

Түйіндеме

ТҮРКИЯДА ШҰҒЫЛ МЕДИЦИНА БӨЛІМІНЕ ТҮСКЕН НАУҚАСТАРДА ИНСУЛЬТТЫ ЕМДЕУ ҚҰНЫН ТАЛДАУ

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Мақсаты: Зерттеу инсультпен ауыратын науқастарды емдеу құнын зерттеуге бағытталған.

Материалдар мен тәсілдер. 2016 жылдың 15 қарашасы мен 2017 жылдың 15 қарашасы аралығында қабылданған инсультпен ауыратын науқастардың деректер базасы құрылды.Шығындар мен пациенттердің демографиясын қорытындылау үшін сипаттамалық статистика пайдаланылды. Параметрлік емес деректерді талдау кезінде Mann-Whitney U-тесті қолданылды. p<0,05 мәні статистикалық маңызды деп саналды.

Нәтижелер. 91 науқас зерттелді, орташа жасы 79 (12) жас. Біздің зерттеуге енгізілген ишемиялық инсультпен ауыратын науқастардың орташа құны 573,78 АҚШ доллары [1307,75 АҚШ доллары] және геморрагиялық инсультпен ауыратын науқастар үшін 1161,69 АҚШ доллары [2128 АҚШ доллары] болды. Біз инсульт түрлері арасындағы шығындардың статистикалық маңызды айырмашылығын таптық (p<0,05). Біздің аурухана үшін геморрагиялық инсультті емдеу құны жоғары болды.

Қорытындылар. Зерттеу нәтижелері бойынша науқастарды емдеудің орташа құны $859,66 құрады. Ол сондай-ақ жыныс пен қосалқы жүретін аурулардың емделу құнына әсер етпейтінін анықтады.

Түйін сөздер: *шұғыл көмек, инсульт, құны.*

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Ильдес С., Кавальчи Ч., Челик К., Тектен Б.О., Кавальчи Г. Анализ затрат на лечение пациентов с инсультом, поступивших в наше отделение неотложной помощи в Турции // Наука и Здравоохранение. 2023. 2(Т.25). С. 35-40. *doi 10.34689/SH.2023.25.2.005*

Ильдес С., Кавальчи Ч., Челик К., Тектен Б.О., Кавальчи Г. Түркияда шұғыл медицина бөліміне түскен науқастарда инсультты емдеу құнын талдау // Ғылым және Денсаулық сақтау. 2023. 2 (Т.25). Б. 35-40. *doi 10.34689/SH.2023.25.2.005*

Introduction

Stroke is one of the leading causes of mortality and morbidity worldwide [15, 24]. The prevalence of stroke has been found to be 0.2% globally [3]. Considering that aging is a real risk factor for stroke, an increase in the number of elderly populations worldwide has led to an increase in stroke incidence rates [1].

Despite advancements in stroke treatment, stroke cases still result in a 30% mortality rate, with 40% of cases resulting in mild disabilities and 30% causing functional loss and disability [3]. While the incidence of stroke is increasing, innovative treatments have started to reduce the prevalence of mortality [15]. However, the increased incidence of stroke has also led to an increase in associated costs, such as the expenses for long-term care and rehabilitation, due to the need for rapid transport of stroke patients to the hospital, improved quality of emergency care, and the use of treatment modalities like thrombolysis and thrombectomy [15].

Numerous scientific studies conducted worldwide have shown the economic burden of stroke cases. In a study conducted in the United States, the total annual direct cost of stroke cases in 2009, including outpatient, rehabilitation, medication, and nursing home stays, was found to be 22.8 billion US dollars ($) [10].

In another study, the direct cost of stroke cases in Iceland, Norway, and Switzerland in 2010 was found to be 26.6 billion euros [13]. Some studies suggest that indirect costs, such as the cost of informal care provided by family members and productivity loss due to morbidity and mortality, may be even greater [6]. Meanwhile, Diestro reported in a study conducted in the Philippines that the median cost of in-hospital stroke was $329.52 [7].

In a study conducted in Turkey, the estimated total annual cost per person was found to be 19.952 ± 13.131 Turkish Liras (TL), with an average of 17.253.50 TL. The study revealed that indirect costs of stroke, such as productivity loss, were higher compared to direct costs [15].

Stroke is an important disease both medically and economically [15]. The cost values associated with the management and care of stroke have led to an increased interest in the economic aspects of stroke [12,13]. A general overview of the economic aspects of stroke is provided in cost-of-illness (COI) studies. Over the years, the number of publications on the economic aspects of stroke has increased significantly [9,10]. The in-hospitalization cost of

stroke (IHCS) can account for as much as 90.9% of all direct medical costs related to stroke [20].

We aimed to investigate the cost of stroke cases in our study by analyzing the epidemiological characteristics and cost analysis of stroke cases, as there are limited studies on the epidemiological characteristics and cost analysis of stroke cases in our country.

Materials and methods

Patient selection and study site

We conducted a retrospective study by reviewing the hospital's patient database and financial records. The study included all adult patients who were 18 years of age or older, diagnosed with either ischemic or hemorrhagic stroke, and presented within 24 hours of the onset of symptoms. The patients were admitted to the hospital between November 15th, 2016, and November 15th, 2017. Patients with a final diagnosis of transient ischemic attack and those who left against medical advice or were transferred to other medical facilities were excluded from the study.

The study site is the Abant İzzet Baysal University Hospital, a public tertiary hospital and the teaching hospital of the state's colleges of medicine and allied medical professions. Patients could choose to be admitted to the hospital's private or "pay" wing, where they pay for their care out-of-pocket or through private insurance. Alternatively, patients could be admitted as "service" patients under the public hospital. The majority of the cost of care at the hospital was covered by government-provided health insurance through the Social Security Agency.

Design and data collection

The hospital automation system was used to determine the IHCS. The study gathered patient data including age, gender, occupation, place of residence, educational level, personal history, time of emergency service application, complaints, physical examination results upon admission, computed tomography and diffusion magnetic resonance imaging findings, type of diagnosed stroke, unit type of hospitalization, treatment type, length of hospital stay, outcome of illness, and cost data analyzed from the time of hospital admission until discharge.

Statistical analysis

All statistical analyses were carried out using IBM's SPSS 20.00 software. Descriptive statistics were used to summarize cost and patients' demographics. Multiple linear regression analyses were conducted to identify the factors that predict the overall cost of stroke. The normality of the data was assessed using the Kolmogorov-Smirnov test. Mann-Witney U test was used in the analysis of nonparametric data. A value of $p<0.05$ was considered statistically significant On November 15th, 2017, we converted all mean cost figures into their corresponding USA dollar ($) values.

Results

After analyzing the patient database of the department, 91 patients were found who could potentially be included in the study. The median age of the patients in the cohort was 79 (12) years, and there was a slightly higher proportion of females, with a ratio of 1.16/1.

Our patients frequently reported weakness on their right side as their primary concern. Table 1 displays the baseline characteristics of the patients, with 74.7% of the cases being ischemic stroke and 25.3% being hemorrhagic.

Table 1.

The basic characteristics of the patients.

Complaint	**n**	**%**
Weakness on the right side	26	28.6
Weakness on the left side	25	27.5
Speech Disorder	18	19.8
Altered Mental Status	9	9.9
General Malaise	7	7.7
Vertigo	4	4.4
Balance Disorder	3	3.3
Numbness	2	2.2
Headache	2	2.2
Syncope	2	2.2
Vision Loss	1	1.1
Fall	1	1.1
Inability to Walk	1	1.1
Medical history		
Hypertension	47	42.2
Hyperlipidemia	13	14.2
Coronary artery disease	27	29
Chronic Kidney Failure	4	4.3
Diabetes Mellitus	11	12
Atrial Fibrilation	20	21.9
Congestive Heart Failure	6	6.5
Previous Stroke	4	4.3

Neuro-surgery was performed in 4.4% of cases. Intravenous thrombolysis was done in 21.7% of cases of ischemic stroke. Based on our study, 56% of our patients were given anticoagulant/antiplatelet therapy and 20.9% received anti-edema treatment. Among the patients in our study, 64% (70.3%) were hospitalized in the intensive care unit, while 27 (29.7%) were admitted to the neurology or brain surgery clinic. The mean length of hospital stay was 15.28 ± 17.39 days, with a median of 10 [12]. 72 (79.1%) patients were discharged from the hospital, while 19 (20.9%) patients died.

The median cost of hospitalization for stroke in the cohort is $859.66 [$1332.5]. According to the variability in costs by gender, the median cost for female stroke patients was $950.39 [$1287.5], while for male stroke patients it was $720.15 [$1755.75], and there was no significant difference between genders in terms of costs. The median cost for ischemic stroke patients included in our study was $573.78 [$1307.75], while for hemorrhagic stroke patients, it was $1161.69 [$2128]. We found a statistically significant difference in costs between stroke types ($p<0.05$). The cost of hemorrhagic stroke to our hospital was higher.

When the relationship between patients' complaints and physical examination findings and cost was examined, we found a statistically significant difference only between the median costs of patients with and without consciousness disorders (Table 2). The cost of stroke patients with consciousness disorders was higher compared to those without. In our study, the median cost of stroke patients with consciousness disorders was $1570.12 [$3821], while the cost of patients without consciousness disorders was $774.81 [$1303]. Therefore, we detected a significant difference between the cost of stroke with consciousness disorders and without ($p<0.05$).

The cost of patients with positive CT findings was higher compared to those with negative CT findings, and a

statistically significant difference was found in terms of cost (p<0.05). Similarly, we found a statistically significant difference in terms of cost between patients with positive and negative MRI findings (p<0.05). The cost of patients without acute pathology on MRI was higher.

Table 2.

The relationship between the demographic and clinical characteristics of the patients and their cost.

Variable	Yes Cost ($)*	No Cost ($)*	p
Hypertension	779.37 [1309]	589.37[1112.5]	0.880
Hyperlipidemia	563.22[789.5]	754.96 [1312.5]	0.428
Coronary artery disease	770.26[1483]	670.31[1236.3]	0.655
Diyabetes Mellitus	437.11[1124]	744.81[1298]	0.467
Atrial fibrilation	1066.15 [1824.6]	567.22[1115]	0.298
Congestive Heart Failure	475.55[500.7]	779.37[1305.5]	0.337
Weakness on the right side	853.93 [1648.5]	859.96 [1323.25]	0.785
Weakness on the left side	825.66 [1331]	959.29 [1502]	0.894
Speech Disorder	561.15 [916.5]	972.16 [1568]	0.206
General Malaise	995.24 [1406]	842.81 [1439]	0.835
Altered Mental Status	1570.12 [3821]	774.81 [1303]	***0.025***
CT finding	1161.69[1522.5	573.78 [1293.5]	**0.033**
MRI finding	555.03[1313.5]	1161.69 [1854]	**0.022**

**Median (Interquartile range)*

The cost of patients followed up in the intensive care unit was $ 1233.48 [$1738], while the cost of patients followed up in the ward was $ 350.59 [153]. There was a statistically significant difference between the unit where patients were followed up and the cost (p<0.001). The cost of discharged patients was $ 759.52 [$1307], while the cost of patients who died was $ 995.24 [$1822]. We did not find a statistically significant difference between groups in terms of cost according to patient outcome (p>0.128).

According to our study, the median cost of treatment for ischemic stroke patients using tPA was $2293.38 $ [3067] $, while the median cost for non-tPA treatment was $392.29 [$581.75]. The cost of tPA treatment was found to be higher, and a statistically significant difference was observed (p<0.05). In the hemorrhagic stroke cases in our study, the median cost of medical treatment was $1088.29 [$795.5], while the median cost of surgical treatment was $6356.36 [$12741]. The cost of surgical treatment was found to be higher and statistically significant (p<0.05).

According to the data in our study, multiple regression analysis was performed to determine the factors affecting the cost. It was found that the independent variable affecting the cost was the hospital unit where the patient was admitted. Thus, it was found that the cost of intensive care unit stays was the most influential factor (Table 3).

Table 3.

Analysis of the factors that affect the cost.

	Odds ratio	P value	95.0% Confidence Interval	
			Lower Bound	Upper Bound
Age	0.105	0.33	-1937.4	5699.994
Gender	0.108	0.31	-2867.62	8929.329
CT	0.123	0.398	-4624.32	11514.14
MRI	-0.002	0.996	-20786.6	20686.82
Stroke type	0.203	0.523	-13689.9	26744.54
Therapy	-0.399	**0.037**	-21992.546	-703.337
Outcome	-0.104	0.369	-11393.8	4279.19

Discussion

This study is the one of reports the in hospitalization cost of stroke in the Turkey. The median cost of hospitalization for stroke in the cohort is $859.66 [$1332.5] in the our study. The cost is similar to other Asian countries but was several magnitudes smaller compared to data developed countries [11-15]. The difference in cost is likely due to the differences in the pricing of health services in the between developed and developing countries. At the time of the study, there was no change in SUT (Health practice notification) prices for more than 10 years.

Factors that were found to be predictive of increased cost in our study included inpatient service, thrombolytic therapy and surgical intervention. Previous studies, the presence of complications such as infection and ischemic heart disease [33,21,4], hemorrhagic and SAH stroke subtypes [20,32], and prolonged hospital stay [22,18] were the most consistent factors resulting in increased stroke costs across all the countries reviewed. In our country, a standard fee is paid by the social security institution for patient admissions. intensive care fees are higher than normal service fees

This study reports the in-hospitalization cost of stroke in Turkey. The median cost of hospitalization for stroke in our cohort was found to be $859.66[$1332.5]. This cost is similar to other Asian countries but significantly lower

compared to data from developed countries [7,25]. The difference in cost is likely due to variations in the pricing of health services between developed and developing countries. At the time of the study, there had been no change in SUT (health practice notification) prices for more than 10 years.

Factors that were found to predict increased cost in our study included inpatient service, thrombolytic therapy, and surgical intervention. Previous studies have found that the presence of complications such as infection and ischemic heart disease, hemorrhagic and SAH stroke subtypes, and prolonged hospital stays were the most consistent factors leading to increased stroke costs across all the countries reviewed [10,20,25,19]. In our country, a standard fee is paid by the social security institution for patient admissions, but intensive care fees are higher than normal service fees.

Some studies examining the relationship between gender and cost have reported that the cost is higher in males [8,1], while others have reported no relationship between gender and cost [17]. In our study, we did not find a relationship between gender and stroke cost. We believe that there is no significant difference in cost based on gender, as the Social Security Institution does not differentiate payments based on gender.

The average cost of hemorrhagic strokes in our study was statistically significantly higher than the cost of ischemic strokes ($p<0.05$). Studies in the literature have shown that the cost of hemorrhagic strokes is higher than that of ischemic strokes [17,5,29,14]. The statistical data comparing the cost of hemorrhagic and ischemic strokes in our study are consistent with the literature. We believe that treatments such as surgery that come into play in cases of hemorrhagic stroke may have increased the cost.

Studies in the literature suggest that comorbidities increase the total cost of stroke [35,33,21]. However, in our study, we did not find a significant relationship between comorbidities and cost. According to previous studies, the highest cost in the annual cost calculation of stroke arises from the acute hospitalization period. The cost of post-hospitalization rehabilitation and home care is also added to the annual cost calculation [8,1,26]. In our study, we found that early admission to the emergency department resulted in higher costs for both ischemic and hemorrhagic stroke cases. We believe that the implementation of surgical treatment for hemorrhagic stroke and tPA treatment for ischemic stroke during early admission increases the costs. However, we also think that these treatments reduce the cost of post-hospitalization rehabilitation and home care.

According to our study, there was a statistically significant higher cost for patients presenting with altered consciousness ($p<0.05$). This is in line with previous studies indicating that altered consciousness and stroke severity increase the cost of care [8,34,2,16,3].

Our data also revealed that patients who required intensive care had a significantly higher hospital cost. This is consistent with previous studies which have also found that patients requiring intensive care have higher costs compared to those who do not require intensive care [17,34,3]. Intensive care services are generally more expensive compared to other services.

It seems that there are different opinions in studies about the relationship between length of hospital stay and cost. Some researchers [17,3] have reported a positive correlation between length of stay and cost, while other [16] have stated that there is no relationship between length of stay and cost. In our study, we found that as the length of hospital stay increased, the cost also increased. This can be attributed to the increased expenses for hospital beds and intensive care unit as the length of stay increases.

In our study, 17 ischemic stroke patients received tPA treatment, while the rest received non-tPA treatment, and the cost analysis of the treatments showed that the cost of those who received tPA treatment was significantly higher. In a study conducted in China by Pan et al. [23], tPA treatment costs were reported to be significantly higher. However, other studies conducted in developed countries such as North America, Europe, and Australia have shown that tPA treatment does not cause high costs and even leads to cost savings in the long term [11,28]. We think that the differences in this regard are due to differences in drug marketing strategies and financing of healthcare systems in different countries.

Limitation

The imitations in our study can be attributed to the small number of patients and the inability to access certain data. Cost limitations include the calculation of patient costs during the acute phase of the disease and being limited to hospital expenses, as well as the inability to access the costs of post-hospitalization physical therapy and rehabilitation. Additionally, the loss of productivity due to mortality and morbidity for patients and their families is unknown. Therefore, our study focused on the direct cost of stroke, and indirect costs could not be examined.

Conclusion

According to our study, we found that the median cost of patients was $859.66. We also observed that gender and comorbidities did not affect the cost. The factors that affected stroke cost were determined to be thrombolytic treatment, surgical treatment, intensive care unit stay, and length of hospitalization.

Data availability. *The anonymized data that support the findings of this study are available from the corresponding author upon reasonable request.*

Declaration of conflicting interests. *The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.*

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References:

1. *Bergman L., van der Meulen J.H., Limburg M., Habbema J.D.* Costs of medical care after first-ever stroke in the Netherlands // Stroke, 1995. 26(10):1830-1836.

2. Caro J.J., Huybrechts K.F., Kelley H.E. Predicting treatment costs after acute ischemic stroke on the basis of patient characteristics at presentation and early dysfunction // Stroke, 2001. 32(1):100-106.

3. Chang K.C., Tseng M.C., Weng H.H., Lin Y.H., Liou C.W., Tan T.Y. Prediction of length of stay of first-ever ischemic stroke // Stroke, 2002. 33(11):2670-2674.

4. *Christensen M.C., Valiente R., Silva S.G., Lee W.C., Dutcher S., Rocha M.S.G., et al.* Acute treatment costs of stroke in Brazil // Neuroepidemiology. 2009, 32:142–149.

5. Çığşar G., User N.N. Analysis of Acute Stroke Patients Admitted to the Emergency Department // Kafkas J Med Sci, 2015. 5(1): 6-12.

6. *Demaerschalk B.M., Hwang H.M., Leung G.* US cost burden of ischemic stroke: a systematic literature review // Am J Manag Care, 2010;16(7):525-533.

7. Diesto J.D.B., Omar A.T., Sarmiento R.J.C., Enriquez C.A.G., Chua-DeCastillo L.L., Ho B.L. Cost of hospitalization for stroke in a low-middle-income country: Findings from a public tertiary hospital in the Philippines // Int J Stroke. 2021;16(1):39-42. doi: 10.1177/1747493020906872.

8. *Diringer M., Edwards D.F., Mattson D.T., Akins P.T., Sheedy C.W., Hsu C.Y., Dromerick A.W.* Predictors of acute hospital costs for treatment of ischemic stroke in an academic center // Stroke, 1999. 30(4):724-728.

9. *Evers S.M., Ament A.J., Blaauw G.* Economic evaluation in stroke research: a systematic review // Stroke, 2000;31(5):1046-1053.

10. *Evers S.M., Goossens M.E., Ament A.J., Maarse J.A.* Economic evaluation in stroke research. An introduction // Cerebrovascular diseases (Basel, Switzerland), 2001. 11(2):82-91.

11. *Fagan S.C., Morgenstern L.B., Petitta A., Ward R.E., Tilley B.C., Marler J.R. et al.* Cost-effectiveness of tissue plasminogen activator for acute ischemic stroke. NINDS rt-PA Stroke Study Group // Neurology, 1998. 50(4):883-90.

12. *Go A.S., Mozaffarian D., Roger V.L., Benjamin E.L., Berry J.D., Borden W.B. et al.* Heart disease and stroke statistics-2013 update: a report from the American Heart Association // Circulation, 2013. 127(1):6-245.

13. *Gustavsson A., Svensson M., Jacobi F., Allgulander C., Alonso J., Beghi E., et al.* Cost of disorders of the brain in Europe 2010 // Eur Neuropsychopharmacol, 2011. 21(10):718-779.

14. Holloway R., Witter Jr.D., Lawton K.B., Lipscomb J., Samsa G. Inpatient costs of specific cerebrovascular events at five academic medical centers // Neurology, 1996. 46(3):854-860.

15. *İçağasıoğlu A., Baklacıoğlu H.Ş., Mesci E., Yumuşakhuylu Y., Murat S., Mesci N.* Economic burden of stroke // Turk J Phys Med Rehabil, 2017. 63(2):155-159.

16. Jorgensen H., Nakayama H., Reith J., Raaschou H.O., Olsen T.S. Factors delaying hospital admission in acute stroke The Copenhagen Stroke Study // Neurology, 1996. 47(2):383-387

17. Kandemir M., Kalyoncu-Aslan I., Bakaç G., Kırbaş D. Cost Evaluation in Acute Stroke // Archives of Neuropsychiatry, 2012. 49(3):72-177.

18. Kwatra G., Kaur P., Toor G., Badyal D.K., Kaur R., Singh Y., Pandian J.D. Cost of stroke from a tertiary center in northwest India // Neurol India. 2013, 61: 627.

19. *Lorenzovici L., Székely A., Csanádi M., Gaál P.* Cost Assessment of Inpatient Care Episodes of Stroke in Romania // Front. Public Health 2020. 8:605919. doi: 10.3389/fpubh.2020.605919

20. *Ng C.S., Toh M.P., Ng J., Ko Y.* Direct medical cost of stroke in Singapore // Int J Stroke 2015. 10: 75–82

21. Nordin N.A.M., Aljunid S.M., Aziz N.A., Nur M. Sulong S. Direct medical cost of stroke: findings from a tertiary hospital in Malaysia // Med J Malaysia, 2012. 67: 472–477

22. Nguyen T., Le T. Inpatient treatment cost of post-stroke: an analysis in hospital of Occupational Diseases and Rehabilitation, Vietnam // Value Heal. 2016, 19:A649

23. Pan Y., Chen O., Zhao X., Liao X., Wang C., Du W., et al., Cost-effectiveness of thrombolysis within 4.5 hours of acute ischemic stroke in China // PloS one, 2014. 9(10):1-8.

24. *Persson J., Ferraz-Nunes J., Karlberg I.* Economic burden of stroke in a large county in Sweden // BMC health services research, 2012. 12(341):1-8.

25. *Rha J.H., Koo J., Cho K.H., Kim E.G., Oh G.S. et al.* Two-year direct medical costs of stroke in Korea: a multi-centre incidence-based study from hospital perspectives // International Journal of Stroke 2012. doi:10. .1111/j.1747-4949.2012.00815.x

26. Reed S.D., Blough D.K., Meyer K., Jarvik J.G. Inpatient costs, length of stay, and mortality for cerebrovascular events in community hospitals // Neurology, 2001. 57(2):305-314.

27. Smurawska L.T., Alexandrov A.V., Bladin C.F., Norris J.W. Cost of Acute Stroke Care in Toronto, Canada // Stroke 1994. 25(8):1628-1631

28. Tanny S.P., Busija L., Liew D., Teo S., Davis S.M., Yan B. Cost-effectiveness of thrombolysis within 4.5 hours of acute ischemic stroke: experience from Australian stroke center.

29. Taylor T.N., Davis P.H., Torner J.C., Holmes J., Meyer J.W., Jacobsonet M.F. Lifetime cost of stroke in the United States // Stroke, 1996. 7(9):1459-1466.

30. *van Eeden M., van Heugten C.M., Evers S.M.* The economic impact of stroke in The Netherlands: the €-restore4stroke study // BMC Public Health, 2012. 12(1):122.

31. *Wang G., Zhang Z., Ayala C., Dunet D., Fang J., George M.* Costs of hospitalization for stroke patients aged 18–64 years in the United States. J Stroke Cerebrovasc Dis 2014; 23: 861–868

32. Yin X., Huang L., Man X., Jiang Y., Zhao X., Zhao L., Cheng W. Inpatient cost of stroke in Beijing: a descriptive analysis // Neuroepidemiology. 2018, 51: 115–122

33. *Yoneda Y., Okuda S., Hamada R., Toyota A., Gotoh J., Watanabe M., et al.* Hospital cost of ischemic stroke and intracerebral hemorrhage in Japanese stroke centers // Health Policy (New York). 2005. 73: 202–211

34. Yoneda Y., Uehara T., Yamasaki H., Kita Y., Tabuchi M., Mori E. Hospital-based study of the care and cost of acute ischemic stroke in Japan // Stroke, 2003. 34(3): p. 718-724

35. Zhao Y., Condon J., Lawton P., He V., Cadilhac D.A. Lifetime direct costs of stroke for indigenous patients adjusted for comorbidities // Neurology 2016. 87. 458-465

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