Diagnosis and Transfer of Stroke Patients by Emergency Medical Services: Case of Vali-Asr hospital, Arak

Saiedeh, Bahrampouri[1]. Hamid Reza, Khankeh[2]. Asghar, Dalvandi[3]

1. MSc In Geriatric Nursing. Member of Student Research Committee, Nursing Department, University of Social Welfare & Rehabilitation Sciences. Tehran. Iran

2. Associated Professor and Post-Doc in Emergency and Disaster Management. Nursing Department. University Of Social Welfare & Rehabilitation Sciences. Tehran. Iran, Department of clinical science and education, Karolinska Institute- Nursing Department. University Of Social Welfare & Rehabilitation Sciences. Tehran. Iran,

E-mail: hamid.khankeh@ki.se- Corresponding Author

3. Assistant Professor and PhD in Aging Health. Nursing Department. University Of Social Welfare & Rehabilitation Sciences. Tehran. Iran

Abstract

Introduction: Stroke is the major cause of death and disability worldwide and emergency care can decrease its complications. Emergency Medical Services (EMS) is able to transfer half of stroke patients to hospital, improving diagnosis accuracy and treatment. This study aimed to investigate the diagnosis and transfer of stroke patients by EMS of a hospital, called Vali-Asr, in Arak, center of Iran.

Methods: This study was a descriptive-analytic study and all 43 patients with a diagnosis of stroke that transferred by EMS to Vali-Asr hospital were selected. Data was gathered thought a checklist which contained information about age, sex, type of pre-hospital setting, response time, time to arrive to scene, transfer time, and total time. To analyze the gathered data, descriptive statistical tests were used.

Results: The Mean (SD) of age in patients were about 73.7±3/8 and 51.2% of them were women. The stroke diagnosis by EMS technicians was correct in 15 cases (34.9%). But this was wrong in 20 cases (46.5%). Eight cases (18.6%) did not have any diagnosis of stroke. Confusion was the most common non-stroke condition. The mean response time and time to arrive to scene, transfer time and total time were 6.9, 16.9, 9.1, and 35.3 minutes respectively. Among patients with correct diagnose these times were 7, 17.1, 3.9 and 35.7 minutes and among wrong diagnosed or ones with no diagnosis they were 6.9, 16.8, 9.7 and 33.5 minutes respectively.

Conclusions: Findings show that accuracy of diagnosis by EMS technicians can be an indicator of fast and on time transfer to healthcare centers.It recommends that we have to develop a pre-hospital diagnosis tool for stroke. This tool should be contextually adopted and also appropriate for accurate diagnosis of stroke. This tool is hoped to improve the quality of care.

Keywords: Diagnosis, transfer time. Stroke, pre-hospital emergency

Introduction

Cerebrovascular disease is the third commons cause of death, and the 6th leading cause disability in the world and expected to move to the 4th place disability and second leading cause of death by 2020 (1) .Today, stroke has many treatments but role of Time is critical in returning blood to the brain and acute stroke care has been made in significantly reducing death and disability (2, 3). Emergency medical services (EMS) is the first medical contact for half of acute stroke patients, So play Undeniable role in survival and prevention of complications in patients (4). Getting "the right patient to the right place in time" is a key to saving lives and reducing disability from stroke (5).

The annual incidence of stroke is 15 million worldwide; over 5.5 million of these patients will die and over Two-thirds of all stroke deaths in the world occur in the developing countries (6, 7). The incidence of stroke per 100,000 per year in Western countries is between100-300 while in Iran populations' based on some altered studies, average

annual stroke attack rates are between 33-372 per 100,000 (8).The case fatality rate at 28 days for all type of stroke reported 12.6% in the world and about 19-31.5% in Iran (9,10).

Age is known as one of the key factors in the incidence of stroke. The risk of stroke doubles for each successive decade after age 55 (3). The annual incidence of elderly stroke (over 45 years) was 500/100,000 population (11). More complications of a stroke in the elderly are also Stroke reduces mobility in more than half of stroke survivors age 65 and over (12). Today, Stroke has been considered one of the most costly diseases because patients Cost of care with acute and chronic disabilities from stroke (9).

A stroke is an interruption of cerebral circulation, occurs when a clot blocks the blood supply to the brain or when a blood vessel in the brain bursts (13, 14). Stroke symptoms may be began with central nervous system function deficit (15). They include sudden weakness or numbness of the face, arm, or leg, especially on one side of the body; sudden

confusion, trouble speaking or understanding; sudden trouble seeing in one or both eyes; sudden trouble walking, dizziness, loss of balance or coordination; or sudden severe headache with no known cause (16). Stroke Signs and symptoms encompass a wide range Today, there are different modalities for treatment of stroke. All effort should be laid on immediate symptom recognition, rapid transport and treatment as soon as possible (19). Several studies have shown that the effectiveness of any stroke therapy is time dependent (19). Because with passing every hour of the onset of untreated stroke , have died 200 million nerve cells and reduced nearly 4 years of one's life (20). The treatment is dependent on time, it means that the difference between returning to work or becoming permanently disabled at home or in a nursing home (5).

The last decade of stroke studies has highlighted the importance of rapid treatment of acute stroke (21,22). Research has shown that speed, knowledge, technology, and these all, could effect on prevention, recognition, and transportation to treatment, post-treatment, and rehabilitation. They can make a vast difference in a stroke victim's outcome (20). Therefore, mortality rates in the first 30 days after stroke have decreased because of advances in emergency medicine care (10).

America Heart Association, for explaining of the best care for stroke patients with 7 D. These "7 D's of Stroke Care" Including: detection (Recognition of stroke signs and symptoms by the patient and family), dispatch (Call 115 and priority EMS dispatch), Delivery (Prompt transport and pre-hospital notification to hospital), door (arrival and urgent triage in the emergency department), data(ED evaluation, prompt laboratory studies, and CT imaging), decision (Diagnosis and decision about appropriate therapy), and drug (Administration of appropriate drugs or other interventions) (23, 24). Thus, both of pre-hospital and hospital services take part in the treatment chain of stroke Patients (19). Pre-hospital phase considered as interval between display onset of symptoms until Reach the appropriate hospital and surround two parts, stroke symptom recognition by patient and family and transferring by EMS (25).

Pre-hospital emergency medical services responded to the call for help, assess the medical needs of individuals, provided Health service delivery in difficult environment outside the hospital sick or injured and transported to appropriate medical facilities (15). In other words, EMS linked hospitals and other medical centers to community، Attempt to provide required emergency information and services to suitable method, in a short time, and the nearest place to patients to prevent from serious

of neurological symptoms, which may also be seen in other central nervous system disorders. These diseases include epilepsy, diabetes dementia, brain tumor and abscess. The most common stroke symptoms mimic is seizure (17, 18).

complications that can threat their lives (26). Paramedics are the first medical contact in 38% to 70%of stroke patients and maximum delay in the assessment and treatment of stroke occurs in Pre-hospital phase (13, 27 and 28). So, emergency medical technicians play an important role in management of patients in acute phase as well as an essential part in stroke treatment team (29, 30).

Adams & et al study shows the benefits of EMS activities for patients with stroke symptoms appear in both the pre-hospital and in-hospital settings. EMS is used strongly associated with decreased transfer time and prevention of neurological deficit in-hospital (23).

The objectives of the EMS phase of stroke care are as follows: (1) rapid and accuracy diagnosis of stroke as the cause of the patient's problems,(2) elimination of co-morbid conditions that could mimic stroke (e.g. epilepsy, diabetes dementia, brain tumor and abscess (18, 27)) , (3) stabilization of patients condition, (4) rapid transportation of the patient to the closest appropriate ED, and (5) notification of the receiving institution about impending arrival of a patient with suspected stroke (23).

Transferring by EMS is most important factor in reducing delays to hospital arrival (31). In dealing with patients outside of the hospital, use of a standardized protocol helps to ensure that the major components of a neurological examination are performed in a timely fashion (17). They can reduce the response time of the Pre-hospital care of these patients (17). Common standard protocols for stroke diagnosis in the world are FAST[1], CPSS[2] and LAPSS[3] (13, 23 and 32). Chenkin et al's study, Following the implementation of a diagnostic protocol in a city, increased number of stroke patients' eligible receive tPA[4] 17.2% (33).

Also, Harbison and Ramanujam studies show that 40 to 79 % of stroke patients are diagnosed correctly by Pre-hospital emergency technicians (34, 35).

The results of studies in America, Australia and Italy show that the percentage of positive results with the drug tPA was exceeded if patients transferring by EMS (36). Therefore, the correct diagnosis of stroke by emergency medical technicians can reduced

---

[1] - Face, Arm, Speech ,Test(FAST)
[2] - Cincinati Prehospital Stroke Scale(CPSS)
[3] - Los Angeles Prehospital Stroke Screen(LAPSS)
[4] - Tissue plasminogen activator(tPA)

transferring delay from onset symptoms to hospital admission, also can prevent from losing treatment resources (16, 34, 37 and 38).

Success in EMS depends on various factors, including those responsible and trained personnel and coordinated communication system (32). So, current situation should be assessed to enhance and strengthen the quality of services performed by the Pre-hospital emergency care (32, 39). Three important criteria in this evaluation include the level of personnel training, equipment, and response time interval (39). Response time can be division to response time, time at the scene and transported to hospital time (39).

This study focus on the issue Pre-hospital stroke diagnosis because importance of issue and lack of adequate research in the field. And, the purpose was to identify existing deficiencies and, if possible, try to resolve it.

In the end, it seems accuracy in Pre-hospital diagnosis and transfer time evolution and relationship between two variables, could describe a clear picture of the status of the current management of stroke patients in Pre-hospital.

Methods

This study was a Descriptive analytical and cross sectional design of consecutive stroke patients transported by EMS to Vali-Asr hospital in Arak city from (01/06/1389) to (1/6/1390). Patients with a final diagnosis of stroke in hospital divided to 3 correct diagnoses, misdiagnosis, no diagnosis of stroke and variables include response time, time at the scene, transfer time and total time were compared in these groups. The population for this study included consecutive patients transported to Vali-Asr hospital by EMS in Arak city over a one-year period from (01/06/1389) to (1/6/1390).

In order to increasing of the validity of the research, study was a census of all individuals who met the inclusion criteria. Inclusion criteria were final hospital-based diagnoses of stroke, matching patient name in hospital record sheets and EMS record sheets, transport by Arak city EMS to Vali-Asr hospital. Patients with missing data for two times or record full patient name were excluded from the main analysis.

Researchers after receiving Institutional ethical approval, referred to Arak city EMS and Vali-Asr hospital, explained about the research objectives, and Emphasis on data confidentiality. Finally, come to an agreement and start of data collection. In addition to ethical considerations in research, names of all patients who meeting the inclusion criteria removed and numeric codes assigned to them. In brief, Arak city EMS services 599634 people in Arak city. Also Arak city EMS having 7 urban based and 6 road base and covering a regional with size of 7178 square kilometers (40, 41). The Vali-Asr hospital (as only stroke state center in the Ostan Markazi) that admits all stroke patients that transfer by Arak city EMS.

In first phase, names of all patients with a final diagnosis of stroke extracted from the archive of patients' records of Vali-Asr hospital (06/01/1389) to (06/01/1390).

The final diagnosis was defined as a final inpatient discharge diagnosis of stroke or CVA that recorded in patients' records by neurologist. The final diagnosis by neurologist is based on computed tomography (as standard clinical criteria for stroke diagnosis). The 231 people were selected in the sample. Therefore, hospital records of all stroke patients assessed and cases transferred by EMS were identified.

The 57 people by Arak EMS, 47 people from other city and 3 people from other hospital in Arak city transferred to Vali-Asr hospital. Current research examined only patients that transferred by Arak EMS.

Then, researchers referred to statistical center Arak EMS, and received stroke patients' data among times interval, early diagnose, demographic characteristic. In this phase, 14 samples because of did not have any records by technicians and did not match in 2 centers were omitted. Finally, population for this study concluded 43 people with finally diagnosis of stroke and transfer by Arak city EMS. Tool for data gathering in this study was researchers-made checklist include age, sex, primary diagnose, time received, time of reach to scene, time of movement from scene and time of arrival at the hospital, which was completed by researchers. Based on above times were calculated response time, Time at the scene, Transport time and Total run time, according to the definitions in Table 1 (42).

Table 1: time interval definition

Time Interval	Definition
Response time	period between the emergency call received and ambulance arrival at the scene
Time at the scene	period between ambulance arrival at the scene and ambulance departure from the scene
Transport time	interval between leaving the scene and arriving at the emergency department
Total run time	response time, scene time and transport time which amount to the total run time

All statistical analyses were conducted with SPSS version19. The demographic characteristics and diagnosis statuses for the study population were compared by $\chi2$ test. Then we used Mann-Whitney test for assessing relationship between diagnosis status and times interval. Mean time intervals (±95% confidence interval) were calculated. A value of P<.05 was considered statistically significant for all tests.

Results
During the study period, from the 231 patients with diagnosis stroke identified then, the 43 patients were included in this study because, they were transported by Arak city EMS and hospitalized in Vali-Asr hospital based on final diagnosis of stroke by physicians ،and had inclusion study criteria. There were more patients older than 55 years (93 %). Most of the subjects were female (51.2%). Stroke frequency in age 75 -85 years in both sexes, males less than 55 years and women aged between 55 to 65 years and 75 to 85 years old were further and did not see significant difference in other ages. The mean age of the study population were 73.7±3.8 years, with the range of 38 to 100 and a mean age men and women were 72 and 75 years, respectively. From the 43 patients, 15 (34.9%) had a correct diagnosis, 20 (46.5%) had a wrong diagnosis and 8(18.6%) did not have a diagnosed by EMS technicians. The mean age of the subjects were 69.4 years at correct diagnosis of 75.9 years at misdiagnosis and 76.6 years at who had no diagnosis.

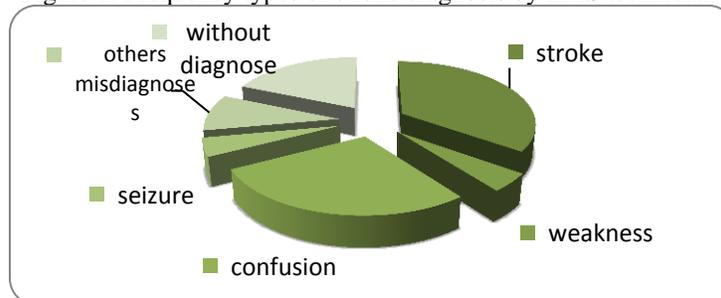Figure 1: Frequency types of stroke diagnosis by EMS technicians

Figure 1 indicates the types of diagnoses for stroke patients by EMS technicians. Confusion was the most prevalent misdiagnosed disease (28%), followed by seizures (5%), weakness (5.1%) and other misdiagnoses (include respiratory problems, infections, dizziness and other neurological problems) (9%).

Table2: Times interval (/min) for all study population

Times interval	mean time		Range
Response time	6.9	1.06±7	15.6-2.4
Time at the scene	16.9	2±17	31.5-8.9
Transport time	9.1	3.6±9	58.1-0.6
Total run time	35.3	4.6±35.1	92.3-18.5

Table3: Times interval (/min)based on type of diagnosis by EMS technicians

Type of diagnose	Times Interval	mean time	Range	SD
Correct diagnosis	Response time	7	15.6-2.4	3.8
	Time at the scene	17.1	26.7-9.8	5.7
	Transport time	3.9	9.3-0.9	2.5
	Total run time	35.7	87.3-20.2	17.3
Wrong diagnosis	Response time	6.5	13.6-2.6	2.8
	Time at the scene	17	31.5-9.3	5.8
	Transport time	12.1	58.1-2.4	15.6
	Total run time	35.7	92.3-18.5	18.2
Without diagnosis	Response time	7.7	10.4-4.2	1.9
	Time at the scene	16.5	26.8-8.9	6.1
	Transport time	9.1	21.9-0.6	6.8
	Total run time	33.3	55.7-22.1	10

Times interval (response time, time at the scene, transfer time and total time) for all study population are given in table 2.

Overall, the average age of people who are misdiagnosed or without diagnosed were 77 years and patients with a correct diagnosis were 69 years.

Table 4: Demographic characteristics at two groups (with correct and wrong or without diagnosis) by EMS technicians

Variable		Diagnosis status		P value
		Correct diagnosis Frequency (%)	Wrong or without diagnosis Frequency (%)	
age	Less than 60years	4 (27%)	3(10.7%)	0.18
	Higher or equal 60 years	11(73%)	25(89.3%)	
sex	Female	6(40%)	16(57%)	0.29
	Male	9(60%)	12(43%)	

Table 4 indicates the demographic characteristics of the separation diagnostic status of sample. The results indicate that, No statistically significant age and sex groups differences were found for correct, wrong, or without diagnosis of stroke by EMS technicians.

Table5: Relationship between times interval and at two groups (with correct and wrong or without diagnosis)

Variable	Diagnosis status by EMS technicians		P value
	Correct diagnosis mean±SD	Wrong or without diagnosis mean±SD	
Response time	3.8±7	2.5±6.9	0.6
Time at the scene	5.7±17.1	5.8±16.8	0.8
Transport time	2.4±3.9	11.2±13.3	0.01
Total run time	17.3±35.7	16±35	0.9

table 5 indicates that response time, Time at the scene, and Total time for patients with stroke did not vary significantly in both groups (correct and wrong or without diagnosis).

Also on 68.4% of stroke patients, the response time was less than 8 minutes long, in which stroke patients had a mean age 73.6 years and 57.7% were female.

Discussion

To review of 231 stroke patients in hospital during this study period indicates that the 25% of stroke patients transported to hospital by EMS. Kleindorfer and Lacy in their studies shown the 38% and two thirds stroke patients transported to hospital by EMS, respectively (43,44). Also, transporting stroke patients allocated 1% emergency accidents in Arak city. Findings of Mosley and Zhang et al shown the 44 and 39.5% of patient used from EMS. Our result was greatly decreased from other similar studies (45, 46). Low utilization of EMS in Arak city, combined with lack of public awareness about critical time for stroke treatment and a lack of trust to the citizens to EMS. Therefore, we suggest that 1) public awareness of the signs and symptoms of stroke, and to expedite transfer of the patient to the appropriate medical facility, 2) making the suitable Strategy for increasing public confidence to EMS with helping of mass media.

Stroke patients transferred by EMS are more prevalent in women than in men. The results of stroke frequency in women were similar to those of Ghandehari et al., which revealing stroke incidence in women 51 to 53% (9). Also other studies supporting results of our study (43, 47-49). Thus, moreover the incidence of stroke is higher for women; most of them are being taken to hospital by EMS. It can be due to that more women attention to the new problems.

The mean age of the study population was 73.7±3.8, which is higher than reported by Kothari et al., that shown mean age of 16 ± 67 years and Frendl et al., with average age 72 year. Also in Iran, the stroke patients' age reported about 61-65 years (8, 48 and 50). These results indicate need to pay more attention to diagnosis and treatment for elderly people. Because of any disability in older age may reduce the patient's autonomy and lead to secondary problems for patients and their families.

Age group distribution for the sample was 9.3% less than 60 years and 90.7% higher than 60 years. In Halpern study, patients ages higher than 45 years were 86% and in Fonarow reported ages of stroke patients were under 60 in 22.6% cases and 60 years or older in 77.4% cases (49, 51). Another study by Chen et al explained the 50% stroke patients were more than 70 years and the 25% older than 80 years (52). In summary, Stroke incidence in patients older than 60 years in our study was high, consistent with studies in the literature.

This study demonstrated that, only, 34.9% of stroke patients were identified correctly by EMS technicians. However, According to some authors, diagnosis accuracy reported Kothari 72%, Ramanujam 40% with utilization diagnostic tools, Andjelic 67.7%, and smith 77% for paramedics who did not use no diagnostic tools and Harbison 79% for paramedics who applied FAST (34, 35, 48, 53 and 54). Therefore, weaknesses in diagnose of stroke patients account to increase in Pre-hospital delay, and in other hands, correct diagnosis of stroke causes to reduce mortality and disability in patients (55). Moreover, any attempt to improve the accuracy of diagnosis by EMS technicians can improve the emergency treatment process.

The results of this study suggest that older patients have higher possible for wrong diagnoses (69 vs.76 years). In our study, weakness, confusion, seizures, respiratory problems, infectious causes, vertigo and other neurological problems (46.5%) were associated with stroke misdiagnosis by EMS technicians. According to some authors among (Kothari and Harbison), the main disorders that misdiagnosed with stroke were infectious causes, including sepsis, pneumonia, Urinary Tract Infection and encephalitis, MI and syncope, seizures, confusion, malignant tumors, psychological disorders, dementia, subdural hemorrhage, drug and alcohol abuse, and peripheral neuropathy (48).This issue can demonstrate EMS technicians are not able for distinguish between stroke and mimics.

In our study mean of response time was 6.9(median=6.7) minutes. However, previous studies reported 13 and 6/5 minutes. Khorasani et al in uromie city reported the response time for traumatic accident that was 5 minutes (56). Also, mean of response time for children in Tehran accounted 14.9 ± 6.7 minutes by Panahi et al (57).Since, arrival to scene enumerate/ consider an important factor in quality assessment of prehospital care service, this amount will be assessed according to a standardized protocol(less than 8 minutes in 80% Services) (58). In the current study, 68.4% response time was less than 8 minutes. Previous studies provided 81.1% in Yazd city and 72/5% in uromie city (56, 39). Panahi et al, founded that 8.5% standard response time for the age group below 15 years having internal problems in Tehran (59). So, it seems that despite the lack of heavy traffic in Arak city, Arak EMS could plan, to improve this time to the standard time of the country.

In this study, means for times interval were time at the scene 16.9 (median=16 min), transfer time 9.1(median=6 min) and Total time 35.3 (median=31.7min) minutes. Kleindorfer study's founded that Time at the scene and transfer time for stroke and TIA patients were 14.1 and 13.1 minutes, respectively (43). Another study that conducted by Bidari et al with purposing to evaluate the performance of pre-hospital care service in patients transported to hazrat-e- rasoul akram hospital, indicated transfer time and Total time were 34 and 47 minutes, respectively (32). According to some authors , reported Total time 71minutes by Puolakka et al, and Time at the scene, transfer time and Total

time equal 6.1,6.3 and 29.2 minutes for motor accident in uromie city (56, 60).

Result from Table 3 showed that the Time at the scene was higher patients with correct diagnosis by EMS technicians than wrong or without diagnose but No statistically significant differences were founded. Also mean of transfer time in patients with correct diagnosis was very different (3.9 vs. 9.1 to 12.1 min). Mean total time from dispatch to arrival at a hospital study site was 35.7 minutes for patients with correct diagnosis and No statistically significant differences with other patients (wrong or without diagnose). In other study by Ramanujam et al, times interval (include response time, transfer time and total time) reported 6, 19 and 39 for patients with correct diagnosis and 5, 20 and 40 for other patients (61). Therefore, our results according with other international studies. Luca and colleagues provided transfer time after and before training course for technicians on stroke has declined from 31.8 to 35.8 minutes (62). Harbison et al, reported that an accurate diagnosis could assist to rapid transfer and transfer to appropriate hospital. Results from these studies are similar to our outcomes, which is consistent with the results of this study (34).

Conclusion

The results of this study showed that, the correct diagnosis by EMS technicians could be resulted faster transferring patient to appropriate hospital. Our data revealed that accuracy of stroke diagnosis in EMS technicians was low, and accuracy of stroke diagnosis has inverse relationship between diagnosis and time of transfer to hospital. In the present time, there is not any standard tool for EMS technicians to diagnose stroke.

Many studies showed that the use of diagnostic tools in pre-hospital, can improve accuracy of diagnosis and transfer time to hospital .It is recommended to develop pre-hospital diagnosis tool of stroke, which is contextually adapted and appropriate to facilitate diagnose of strokes and improve the quality of care.

References

1. Mousavi Ls, Lotfi R, Dadkhah Tehrani T, Abedini Z, Khorami A. Risk Factor Frequencies In Ischemic And Hemorrhagic Stroke: A Comparative Study. Faculty Of Nursing Of Midwifery Quarterly. 2009. (Persian).

2. Edlow JA, Selim MH. Neurology emergencies. New York: Oxford University Press; 2011.

3. Goldstein LB, Bushnell CD ,Adams RJ, Appel LJ, Braun LT, Chaturvedi S, et al. Guidelines for the Primary Prevention of Stroke,A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. Stroke. 2011;42:517-4

4.Deakin C, Alasaad M, King P, Thompson F. Is ambulance telephone triage using advanced medical priority dispatch protocols able to identify patients with acute stroke correctly? Emergency Medicine Journal. 2009;26(6):442-5.Bowman S, Jethro De Lisle. Emergency Cardiac and Stroke Care in Washington. Washington state department of health; 2008.

 Qiu Y, Li S. Stroke: coping strategies and depression among Chinese caregivers of survivors during hospitalisation. Journal of clinical nursing. 2008;17(12):1563-73.

5.Brainin M, Heiss W-D, Heiss S. Textbook of Stroke Medicine. New York: Cambridge University Press; 2010.

6.Dalvandi A, Sirka L. Post stroke life in Iranian people :used and recommended strategics. Iranian rehabilitation journal 2009;7(9).

7.Hosseini AA, Sobhani-Rad D, Ghandehari K, Bename HT. Frequency and clinical patterns of stroke in Iran - Systematic and critical review.

8.BMC Neurology 2010;10(72).Summers D, Leonard A, Wentworth D, Saver JL, Simpson J, Spilker JA, et al. Comprehensive Overview of Nursing and Interdisciplinary Care of the Acute Ischemic Stroke Patient. Stroke. 2009;40:2911-44.

9.Salman-Roghani R ,Delbari A, Tabatabae SS. Stroke rehabilitation: Principles, advances, early experiences, and realities in Iran. Quarterly Journal of Sabzevar University of Medical Sciences. 2012;19(2). (Persian).

10. CDC. Stroke Fact Sheet. 2012 [cited 2012]; Available from: http//:www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_stroke.html.

11. Bray JE, Martin J, Cooper G, Barger B, Bernard S, Bladin C. An interventional study to improve paramedic diagnosis of stroke. Prehospital Emergency Care. 2005;9(3):297-302.

12. Buettner JR .Fast facts for the ER nurse: neurological emergency New York: Springer Publishing Company, LLC; 2010.

13. Mitchel E, Medzon R. Emergency medicine: Lippincott Williams& wilkins; 2005.

14. Care E. Part 9: Adult Stroke. hospital (Box 2). 2005;25:28.

15. Gladstone DJ, Rodan LH, Sahlas DJ, Lee L, Murray BJ, Ween JE, et al. A citywide prehospital protocol increases access to stroke thrombolysis in Toronto. Stroke. 2009;40(12):3841-4.

16. Mistovich J, Karren K, hafen B. prehospital emergency care: Intermediate.(Translator group). 4 ed. Tehran: Simindikht pub; 2010. (Persian).

17. Kurz M, Kurz K, Farbu E. Acute ischemic stroke – from symptom recognition to thrombolysis. Acta Neurol Scand 2013;127(196):57-64.

18. Vinuela F. UCLA Brain stroke rescue program: Time is brain. 2010.

19. Iqbal A. The 'Golden Hour' Treatment of Acute Ischemic Stroke. Medicine & Health/Rhode Island. 2011;94(12).

20. McGruder HF, Croft JB, Zheng Z-J. Characteristics of an "Ill-Defined" Diagnosis for Stroke Opportunities for Improvement. Stroke. 2006;37:781-9.

21. Adams Jr HP, del Zoppo G, Alberts MJ, Bhatt DL, Brass L, Furlan A, et al. Guidelines for the early management of adults with ischemic stroke. Circulation. 2007;115(20):e478-e534.

22. Association AH .Part 7: The era of reperfusion. Circulation. 2000;102.

23. Kue R, Steck A. Prehospital diagnosis and management of patients with a cute stroke. Emergency Medicine Clinics Of North America [Emerg Med Clin North Am]. 2012;30(3):617-35.

24. Haghani F, Sadeghi N. Training in Pre-hospital Emergency: Needs and Truths. Iranian Journal Of Medical Education. 2011;10(5):1273. (Persian).

25. Abdullah AR, Smith EE, Biddinger PD, Kalenderian D, Schwamm LH. Advance Hospital Notification by EMS in Acute Stroke Is Associated with Shorter Door-to-Computed Tomography Time andIncreased Likelihood of Administration of Tissue-Plasminogen Activator. Prehospital Emergency Care. 2008;12(4):426-31.

26. Ingolfsson A, Budge S, Erkut E. Optimal ambulance location with random delays and travel times. Health Care Management Science. 2008;11(3):262-73.

27. Llanes JN, Kidwell CS, Starkman S, Leary MC, Eckstein M, Saver JL. The Los Angeles Motor Scale (LAMS): A new measure to characterize stroke severity in the field. Prehospital Emergency Care. 2004;8(1):46-50.

28. Bray JE, Coughlan K, Barger B, Bladin C. Paramedic Diagnosis of Stroke Examining Long-Term Use of the Melbourne Ambulance Stroke Screen (MASS) in the Field. Stroke. 2010;41(7):1363-6.

29. Wojner AW, Morgenstern L, Alexandrov AV, Rodriguez D, Persse D, Grotta JC. Paramedic and emergency department care of stroke: baseline data from a citywide performance improvement study. American Journal of Critical Care. 2003;12(5):411-7.

30. Bidari A, Abbasi S, Farsi D, Saeidi H, Mofidi M, Radmehr M ,et al. Quality Assessment Of Prehospital Care Service In Patients Transported To Hazrat-E- Rasoul Akram Hospital. Medical Journal Of Tabriz University Of Medical Sciences 2007;29(3):43-6. (Persian).

31. Chenkin J, Gladstone DJ, Verbeek PR, Lindsay P, Fang J, Black SE, et al. Predictive value of the Ontario prehospital stroke screening tool for the identification of patients with acute stroke. Prehospital Emergency Care. 2009;13(2):153-9.

32. Harbison J, Hossain O, Jenkinson D, Davis J, Louw SJ, Ford GA. Diagnostic accuracy of stroke referrals from primary care, emergency room physicians, and ambulance staff using the face arm speech test. Stroke. 2003;34(1):71-6.

33. Ramanujam P, Guluma KZ, Castillo EM, Chacon M, Jensen MB, Patel E, et al. Accuracy of Stroke Recognition by Emergency Medical Dispatchers andParamedics-San Diego Experience. Prehospital Emergency Care. 2008;12(3):307-13.

34. Jauch EC, Cucchiara B, Adeoye O, Meurer W, Brice J, Gentile N, et al. Part 11: Adult Stroke 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122(18 suppl 3):S818-S28.

35. Acker JE, Pancioli AM, Crocco TJ, Eckstein MK, Jauch EC, Larrabee H, et al. Implementation Strategies for Emergency Medical Services Within Stroke Systems of Care A Policy Statement From the American Heart Association/American Stroke Association Expert Panel on Emergency Medical Services Systems and the Stroke Council. Stroke. 2007;38(11):3097-115.

36. Zweifler RM, York D, U TT, Mendizabal JE, Rothrock JF. Accuracy of Paramedic Diagnosis of Stroke. Journal of Stroke and Cerebrovascular Diseases. 1998;7(6):446-8.

37. Bahrami M, Ezzatabadi M, Maleki A, Asquari R, Ahmadi Tehrani G. A Survey On The Yazd Prehospital Emergency Medical Services Performance Assessment,2009-2010. Toloo-E-Behdasht. 2011;9(4):45-59. (Persian).

38. Iran SCo. 1390; Available from: www.amar.org.ir. (Persian).

39. Arak city. [2012/31/05]; Available from: http://www.tebyan.net/newindex.aspx?pid=20854. (Persian).

40. Altintas K, Bilir N. Ambulance times of Ankara emergency aid and rescue services' ambulance system. EUROPEAN JOURNAL OF EMERGENCY MEDICINE. 2001;8(1):43-50.

41. Kleindorfer DO, Lindsell CJ, Broderick JP, Flaherty ML, Woo D, Ewing I, et al. Community Socioeconomic Status and Prehospital Times in Acute Stroke and Transient Ischemic Attack Do Poorer Patients Have Longer Delays From 911 Call to the Emergency Department? Stroke. 2006;37(6):1508-13.

42. Lacy CR, Suh D-C, Bueno M, Kostis JB. Delay in Presentation and Evaluation for Acute Stroke Stroke Time Registry for Outcomes Knowledge and Epidemiology (S.T.R.O.K.E.). Stroke. 2001;32:63-9.

43. Mosley I, Nicol M, Donnan G, Patrick I, Dewey H. Stroke symptoms and the decision to call for an ambulance. Stroke. 2007;38(2):361-6.

44. Zhang S, Hu D, Wang X, Yang J. Use of emergency medical services in patients with acute myocardial infarction in China. Clinical cardiology. 2009;32(3):137-41.

45. Nagaraja N, Bhattacharya P, Mada F, Salowich-Palm L, Hinton S, Millis S, et al. Gender based differences in acute stroke care in Michigan hospitals. Journal of the neurological sciences. 2012;314(1):88-91.

46. Kothari R, Barsan W, Brott T, Broderick J, Ashbrock S. Frequency and accuracy of prehospital diagnosis of acute stroke. Stroke. 1995;26(6):937-41.

47. Fonarow GC, Reeves MJ, Zhao X, Olson DM, Smith EE, Saver JL, et al. Age-related differences in characteristics, performance measures, treatment trends, and outcomes in patients with ischemic stroke. Circulation. 2010;121(7):879-91.

48. Frendl DM, D.G.Strauss, B.K.Underhill, L.B.Goldstein. Lack of impact of paramedic training and use of the cincinnati prehospital stroke scale on stroke patient identification and on-scene time. Stroke. 2009;40(3):754-6.

49. Halpern M, Meier N, Fischer U, Haefeli T, Kappeler L, Brekenfeld C, et al. Age-dependent differences in demographics, risk factors, co-morbidity, etiology, management, and clinical outcome of acute ischemic stroke. Journal of neurology. 2008;255(10):1503-7.

50. Chen R-L, Balami JS, Esiri MM, Chen L-K ,Buchan AM. Ischemic stroke in the elderly: an overview of evidence. Nature Reviews Neurology. 2010;6(5):256-65.

51. Andjelic SL. Accuracy of Prehospital Diagnosis of Stroke. Ceska a Slovenska neurologie a neurochirurgie. 2012;75(1):62-8.

52. Smith WS, Isaacs M, Corry MD. Accuracy of paramedic identification of stroke and transient ischemic attack in the field. Prehospital Emergency Care. 1998;2(3):170-5.

53. Sayre MR. Damage control: past, present, and future of prehospital stroke management. Emergency medicine clinics of North America. 2002;20(4).

54. Khorasani-Zavareh D, Bigdeli M, Mohammadi R. Pre-hospital care time intervals among victims of road traffic injuries in Iran. A cross-sectional study. BMC public health. 2010;10(1):406.

55. Panahi Farzad K, Azizabadi Faraahani M, Khodami Vishteh H, Asaari S. Time Indices Of Pediatric Prehospital Emergency Care In Tehran, 2006. Journal Of Iran University Of Medical Sciences. 2008. (Persian).

56. Iran lows. Collection of laws in medical health, treatment and education. Tehran:Payam -e Edalat. 1388. (Persian).

57. Panahi F, Mohebbi HA, Farahani MA, Vishteh HRK, Assari S .Prehospital Emergency Service for Internal Medicine Problems in Pediatrics; Causes, Time Indices and Outcomes. Iranian Journal of Pediatrics. 2007;17(Suppl 2). (Persian).

58. Puolakka T, Väyrynen T, Häppölä O, Soinne L, Kuisma M, Lindsberg PJ. Sequential analysis of pretreatment delays in stroke thrombolysis. Academic Emergency Medicine. 2010;17(9):965-9.

59. Ramanujam P, Castillo E, Patel E, Vilke G, Wilson MP, Dunford JV. Prehospital transport time intervals for acute stroke patients. The Journal of emergency medicine. 2009;37(1):40-5.

60. Luca AD, Toni D, Lauria L, Sacchetti ML, Rossi PG, Ferri M, et al. An emergency clinical pathway for stroke patients – results of a cluster randomised trial. BMC Health Services Research 2009;9(14).