

## Original Article

DOI: 10.22114/ajem.v0i0.25

## Emergency Overcrowding Impact on the Quality of Care of Patients Presenting with Acute Stroke

Mehdi Momeni<sup>1</sup>, Elnaz Vahidi<sup>1</sup>, Javad Seyedhosseini<sup>1</sup>, Alemeh Jarchi<sup>1</sup>, Zeinab Naderpour<sup>2</sup>, Morteza Saeedi<sup>1\*</sup>

1. Department of Emergency Medicine, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran.

2. Department of Internal Medicine, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran.

\*Corresponding author: Morteza Saeedi; Email: m\_saeedi@tums.ac.ir

### Abstract

**Introduction:** Emergency overcrowding is defined as when the amount of care required for patients overcomes the available amount. This can cause delays in delivering critical care in situations like stroke.

**Objective:** The aim of this study was to assess the possible impact of emergency department (ED) crowding on the quality of care for acute stroke patients.

**Methods:** In this cross-sectional prospective study, all patients with symptoms of acute stroke presenting to the ED of educational hospitals were enrolled. All patients were assessed and examined by the emergency medicine (EM) residents on shift and a questionnaire was filled out for them. The amount of time that passed from the first triage to performing the required interventions and delivering health services were recorded by the triage nurse. ED crowding was measured by the occupancy rate. Then, the correlation between all of the variables and ED crowding level were calculated.

**Results:** The average daily bed occupancy rate was  $184.9 \pm 54.3\%$ . The median time passed from the first triage to performing the interventions were as follows: the first EM resident visit after 34 min, the first neurologic visit after 138 min, head CT after 134 min, ECG after 104 min and ASA administration after 210 min. There was no statistically significant relationship between the ED occupancy rate and the time elapsed before different required health services in the management of stroke patients either throughout an entire day or during each 8-hour interval ( $p > 0.05$ ).

**Conclusion:** In the current study, the ED occupancy rate was not significantly correlated with the time frame associated with management of admitted acute stroke patients.

**Key words:** Bed occupancy; Emergency service, hospital; Health services; Quality of health care; Stroke

**Cite this article as:** Momeni M, Vahidi E, Seyedhosseini J, Jarchi A, Naderpour Z, Saeedi M. Emergency Overcrowding Impact on the Quality of Care of Patients Presenting with Acute Stroke. *Adv J Emerg Med.* 2018;2(1):e3.

### INTRODUCTION

Over 100 million visits occur annually to emergency departments (ED)s of the United States. Nowadays there are reports of overcrowding of many EDs all around the world, which has caused a great deal of concern about the adequacy of emergency service capacity (1-3). Overcrowding is a sign of a systemic problem and its underlying reasons are divided into three principal categories of input, throughput, and output problems. Input problems are generally related to non-urgent visits like "frequent-flyer patients" (4-6). Throughput problems are usually referred to as problems related to the care and treatment process in EDs. The most important reason behind this core problem is the lack of qualified health care providers (7). In the output section, the reasons are usually related to delays in admission of patients to their relevant wards (8, 9). The effects of ED

overcrowding on the quality of health care services is an important measurement that may take into account throughput problems.

There are some critical diagnoses in which time elapsed before treatment has a major impact on patient outcomes, including stroke. Urgent management in the first few hours after stroke presentation is vital. This requires an early clinical diagnosis following proper history taking, a physical examination, and conducting standard imaging modalities (10, 11). The recent guideline on adult stroke, released by the National Institute of Neurological Disorders and Stroke (NINDS), has recommended performing a brain computed tomography (CT) scan within the first 25 minutes of patient admission. They have also declared that the CT scan should be read within the first 45 minutes, and thrombolytic drugs should be

administered within 60 minutes (door to treatment) if indicated (12, 13). Stroke management should be initialized as soon as possible. Prompt presentation and evaluation are critical to obtain a good outcome and prognosis, but it has been claimed that ED crowding can cause delays in proper care of patients presenting to the ED. In this study, we decided to evaluate the possible effect of ED crowding on the management of patients with acute stroke presentation.

## METHODS

### Study design

This cross-sectional prospective study was performed in the ED of Shariati Hospital, Tehran, Iran during the year 2014. This hospital is a tertiary referral hospital. The ED consist of four main parts with different acuity based on the triage level including emergent part 1, emergent part 2, fast track exam room, cardiorespiratory resuscitation (CPR) room, and the triage room. One emergency medicine (EM) resident is present in each part fulltime and one EM resident is in charge 24 hours a day, 7 days a week. These two hospitals have almost the same number of beds, staff, and resources. The study protocol was approved by the ethical committee of the Tehran University of Medical Sciences.

### Study population

All patients older than 18 years old that presented with any focal neurologic deficits suggestive of acute stroke (ischemic, hemorrhagic, transient ischemic attack) were enrolled. Patients who were unwilling to share their data with us, patients who left the hospital before entering their data in questionnaires, patients who had concomitant head trauma, and patients who did not know the exact onset time of their presentations, and those with persistence of symptoms for more than a day were excluded.

### Data gathering

Patients were assessed for having the criteria and enrollment in the study by the triage nurse or EM residents. Patients were admitted to the appropriate ED section based on their triage level

and were visited by the EM resident. A pre-prepared checklist including demographic data, time of onset of the symptoms, the first EM resident visit, the first neurology resident visit, time of performing the brain CT and electrocardiogram recording, and time of aspirin administration were recorded by the investigator.

### Definitions

Each 24-hour-shift was divided into three 8-hour-intervals (morning: 8 a.m. to 4 p.m. evening: 4 p.m. to 12 a.m. night: 12 a.m. to 8 a.m.).

ED crowding in each time interval was calculated by the occupancy rate formula. The occupancy rate is defined by the total number of patients in the ED divided by the number of licensed ED beds (14).

### Primary and secondary endpoints

The relationships between the averages of all variables were evaluated with the average occupancy rate during the three mentioned time intervals. The primary endpoint was to evaluate the correlation between the time spent in stroke management with the ED occupancy rate during the three time intervals (morning, evening, night). One of our secondary endpoints was to determine the time interval with the greatest occupancy rate and the time interval with the longest delay in stroke management. The other was to estimate the average time spent before performing different steps of stroke management.

### Statistical analysis

All recorded data were checked for normality and were analyzed by SPSS version 21. Data are presented as means and standard deviation (SD), frequencies, or medians with interquartile ranges (IQRs) for nonparametric time data. The correlation between the ED occupancy rates with the study variables were assessed with correlation analysis. Because the occupancy rates of the two hospitals were the same, we reported the average time of the different items in the two hospitals together. A P-value < 0.05 was defined as significant.

## RESULTS

One hundred and four patients with symptoms

**Table 1:** The baseline characteristics and values of the enrolled patients

Variable	Mean $\pm$ SD	Median (Min-Max)
Age (year)	68.7 $\pm$ 11.1	69 (34-92)
Admitted patients (number)	55.5 $\pm$ 16.3	58 (22-98)
Emergency department occupancy rate (percent)	184.9 $\pm$ 54.2	193.3 (73.3-328.3)
Triage to EM physician visit (min)	42 $\pm$ 30	34 (5-140)
Triage to neurologist visit (min)	148 $\pm$ 99	138 (5-545)
Triage to ECG (min)	114 $\pm$ 65	104 (15-366)
Triage to brain CT (min)	135 $\pm$ 58	2:14 (35-366)
Triage to aspirin administration (min)	221 $\pm$ 69	210 (60-480)

**Table 2:** The mean of baseline measured values in each of the time intervals

Time periods	Morning	Evening	Night
	Mean ± SD*		
Triage to EM physician visit	39 ± 31	43 ± 30	47 ± 25
Triage to neurologist visit	163 ± 111	132 ± 89	139 ± 65
Triage to ECG	111 ± 60	125 ± 71	117 ± 60
Triage to brain CT	126 ± 57	143 ± 57	142 ± 63
Triage to aspirin administration	190 ± 66	227 ± 69	243 ± 49

\*values are presented in minutes

**Table 3:** The relationship of the ED occupancy rate with time spent for different required health services during various time intervals

Time periods	24 hours	Morning	Evening	Night
	p-value*			
Triage to EM physician visit	0.86	0.30	0.64	0.98
Triage to neurologist visit	0.51	0.93	0.53	0.32
Triage to ECG	0.56	0.73	0.81	0.62
Triage to brain CT	0.57	0.17	0.21	0.51
Triage to aspirin administration	0.67	0.67	0.67	0.12

\*Based on the findings of Spearman's correlation test

suspicious of acute stroke were enrolled. The average age was  $68.7 \pm 11.1$  years old and 62 (59.6%) patients were men. The baseline characteristics and values of the patients have been summarized in Table 1.

The mean ED occupancy rate in the morning, evening, and night were as follows, respectively:  $184.55 \pm 54.36$ ,  $190.98 \pm 54.57$ , and  $160.35 \pm 50.11$ . The mean baseline measured values in each of various time intervals are shown in Table 2.

The relationship of the ED occupancy rate with the measured time spent for different required health services during the various three 8-hour intervals was evaluated and the results are shown in Table 3. There was no statistically significant relationship between the occupancy rate and the time spent for different required health services in the management of stroke patients either by day or for each of the 8-hour intervals ( $p > 0.05$ ).

### DISCUSSION

Based on the findings of the current study, the ED occupancy rate had no statistically significant effect on required health services for patients suspicious for stroke. There are generally four basic patterns recognized in ED overcrowding impacts: adverse outcomes, decreased quality, impaired access, and provider losses. Unpleasant consequences are the mortality and morbidity threatening patients' lives (15-20). Delays in patients' transfers or treatment are examples of declines in the quality of care (21). The complexity in ED overcrowding problems has some remedies. The most useful solutions are: 1) increasing the resources, 2) demand management, and 3) operations research (22-25).

In 2015, a systematic review was published and it

introduced three main factors related to the quality of care of patients, including the number of patients awaiting triage, the ED occupancy rate, and the number of patients on the waiting list for wards' admission (26). In contrast, we could not find a significant relationship between the ED occupancy rate and the quality of care for stroke patients. Jungehulsing et al. evaluated the leading factors affecting patients' care in acute stroke. Their study revealed that more acute presentation, a more severe initial National Institutes of Health Stroke Scale (NIHSS), admission at two specific hospitals, admission on weekends, and having private health insurance were significantly associated with fewer delays (27). Ben-Yakov et al. in 2015 showed that greater severity of ED crowding was related to a lower likelihood of discharge for transient ischemic attack and minor strokes (28).

In confirmation of the results of this study, Chaterjee et al. in 2011 concluded that ED crowding was not associated with care delays in thrombolysis-eligible patients with stroke. However, they showed that patients with symptoms for longer than 3 hours and without thrombolytic indications experienced CT delays during higher levels of ED crowding (29). In addition, Chen et al. in 2006 showed that the presence of concurrent trauma evaluation, which causes higher ED crowding, did not delay CT imaging of patients with a suspicion of stroke (30). Madej-Fermo et al., in a retrospective study, also showed that nursing shift changes and time of transition of care did not cause delays in thrombolytic administration in eligible patients with a diagnosis of acute ischemic stroke (31).

It seems that the discrepancy in the viewpoints of

various researchers is still present in this subject. Therefore, to promote discussion and eventual generalization of the results, and considering the urgency of administering therapeutic measures in acute stroke, we recommend performing additional studies with greater sample sizes in this field.

#### **Limitations**

We evaluated the occupancy rate in only one tertiary referral hospital in Tehran, so our results may not be generalizable. We calculated the ED crowding by the occupancy rate; it has been suggested that other formulas may estimate ED crowding more accurately. Documentation error is an important problem in our study, and thus it was difficult to determine the exact timing of some items. We could not assess the time of thrombolytic administration in our study, because most of them were referred to the ED after 3 hours of stroke presentation, and in consequence, there were only a few patients fulfilling the criteria for its administration.

#### **CONCLUSIONS**

#### **REFERENCES**

1. Derlet RW. Triage and ED Overcrowding: Two Cases of Unexpected Outcome. *Cal J Emerg Med.* 2002;3(1):8-9.
2. Baratloo A, Maleki M. Iranian emergency department overcrowding. *JEPT.* 2015;1(2):39.
3. Baratloo A, Maleki M. Description of a Working Day as a Senior Emergency Medicine Resident; Burning Candle at Both Ends! *Emergency.* 2015;3(1):1.
4. Hoot NR, Aronsky D. Systematic review of emergency department crowding: Causes, effects, and solutions. *Ann Emerg Med.* 2008;52(2):126-36.
5. Dent AW, Phillips GA, Chenhall AJ, McGregor LR. The heaviest repeat users of an inner city emergency department are not general practice patients. *Emerg Med (Fremantle).* 2003;15(4):322-9.
6. Glaser CA, Gilliam S, Thompson WW, Dassey DE, Waterman SH, Saruwatari M, et al. Medical care capacity for influenza outbreaks, Los Angeles. *Emerg Infect Dis.* 2002;8(6):569-74.
7. Schneider SM, Gallery ME, Schafermeyer R, Zwemer FL. Emergency department crowding: A point in time. *Ann Emerg Med.* 2003;42(2):167-72.
8. Schull MJ, Szalai JP, Schwartz B, Redelmeier DA. Emergency department overcrowding following systematic hospital restructuring: Trends at twenty hospitals over ten years. *Acad Emerg Med.* 2001;8(11):1037-43.
9. Warden CR, Bangs C, Norton R, Huie J. Temporal trends in ambulance diversion in a mid-sized metropolitan area. *Prehosp Emerg Care.* 2003;7(1):109-13.
10. Adams HP dZG, Alberts MJ, Bhatt DL, Brass L, Furlan A, et al. Guidelines for the early management of adults with ischemic stroke: a guideline from the American Heart Association/American Stroke Association Stroke Council, Clinical Cardiology Council, Cardiovascular Radiology and Intervention Council, and the Atheros. *Circulation.* 2007;115(20):478-534.
11. Kasmaei HD, Baratloo A, Nasiri Z, Soleymani M, Yazdani MO. Recombinant tissue plasminogen activator administration in patients with cerebrovascular accident; a case series. *Arch Neurosci.* 2015;2(2):e23315.

In the current study, the ED occupancy rate had no significant effect on the management of admitted acute stroke patients.

#### **ACKNOWLEDGEMENTS**

We do not have any acknowledgements This paper has been extracted from Dr. Alemeh Jarchi's thesis for emergency medicine specialist degree at Tehran University of Medical Sciences, Tehran, Iran.

#### **AUTHORS' CONTRIBUTION**

All authors contributed to drafting/revising the manuscript, the study concept and design, and analysis or interpretation of the data.

#### **CONFLICT OF INTEREST**

The authors declare that there are no conflicts of interest.

#### **FUNDING**

Non declared.

12. Fonarow GC, Zhao X, Smith EE, Saver JL, Reeves MJ, Bhatt DL, et al. Door-to-needle times for tissue plasminogen activator administration and clinical outcomes in acute ischemic stroke before and after a quality improvement initiative. *Jama*. 2014;311(16):1632-40.
13. Baratloo A, Forouzanfar MM, Hashemi B, Safari S, Kasmaei HD, Rouhipour A, et al. Tissue plasminogen activator: A literature review. *Arch Neurosci*. 2016;3(1):e30452.
14. Boyle A, Beniuk K, Higginson I, Atkinson P. Emergency department crowding: time for interventions and policy evaluations. *Emerg Med Int*. 2012;2012:838610.
15. Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. *Med J Australia*. 2006;184(5):213-6.
16. Cha WC, Shin SD, Song KJ, Jung SK, Suh GJ. Effect of an Independent-capacity Protocol on Overcrowding in an Urban Emergency Department. *Acad Emerg Med*. 2009;16(12):1277-83.
17. Weiss SJ, Derlet R, Arndahl J. Estimating the degree of emergency department overcrowding in academic medical centers: results of the National ED Overcrowding Study (NEDOCS). *Acad Emerg Med*. 2004;11(4):408-.
18. Pines JM, Hollander JE, Localio AR, Metlay JP. The association between emergency department crowding and hospital performance on antibiotic timing for pneumonia and percutaneous intervention for myocardial infarction. *Acad Emerg Med*. 2006;13(8):873-8.
19. Pines JM, Hollander JE. Emergency department crowding is associated with poor care for patients with severe pain. *Ann Emerg Med*. 2008;51(1):1-5.
20. Pines JM, Iyer S, Disbot M, Hollander JE, Shofer FS, Datner EM. The effect of emergency department crowding on patient satisfaction for admitted patients. *Acad Emerg Med*. 2008;15(9):825-31.
21. Proceedings of a National Symposium on Rapid Identification and Treatment of Acute Stroke. National institute of neurological disorders and stroke. 1996.
22. Bucheli B, Martina B. Reduced length of stay in medical emergency department patients: a prospective controlled study on emergency physician staffing. *Eur J Emerg Med*. 2004;11(1):29-34.
23. Bazarian JJ, Schneider SM, Newman VJ, Chodosh J. Do admitted patients held in the emergency department impact the throughput of treat-and-release patients? *Acad Emerg Med*. 1996;3(12):1113-8.
24. McConnell KJ, Richards CF, Daya M, Bernell SL, Weathers CC, Lowe RA. Effect of increased ICU capacity on emergency department length of stay and ambulance diversion. *Ann Emerg Med*. 2005;45(5):471-8.
25. Derlet RW. Primary-Care and Public Emergency Department Overcrowding .2. Successful Referrals to Primary-Care Clinics. *Am J Public Health*. 1994;84(1):123-4.
26. Stang AS, Crotts J, Johnson DW, Hartling L, Guttman A. Crowding Measures Associated With the Quality of Emergency Department Care: A Systematic Review. *Acad Emerg Med*. 2015;22(6):643-56.
27. Jungehulsing GJ, Rosznagel K, Nolte CH, Muller-Nordhorn J, Roll S, Klein M, et al. Emergency department delays in acute stroke - analysis of time between ED arrival and imaging. *Eur J Neurol*. 2006;13(3):225-32.
28. Ben-Yakov M, Kapral MK, Fang JM, Li SD, Vermeulen MJ, Schull MJ. The Association Between Emergency Department Crowding and the Disposition of Patients With Transient Ischemic Attack or Minor Stroke. *Acad Emerg Med*. 2015;22(10):1145-54.
29. Chatterjee P, Cucchiara BL, Lazarcic N, Shofer FS, Pines JM. Emergency Department Crowding and Time to Care in Patients With Acute Stroke. *Stroke*. 2011;42(4):1074-80.
30. Chen EH, Mills AM, Lee BY, Robey JL, Zogby KE, Shofer FS, et al. The impact of a concurrent trauma alert evaluation on time to head computed tomography in patients with suspected stroke. *Acad Emerg Med*. 2006;13(3):349-52.
31. Madej-Fermo OP, Staff I, Fortunato G, Abbott L, McCullough LD. Impact of Emergency Department Transitions of Care on Thrombolytic Use in Acute Ischemic Stroke. *Stroke*. 2012;43(4):1067-74.