

Effectiveness of Five-Level Emergency Severity Index Triage System Compared With Three-Level Spot Check: An Iranian Experience

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Abstract

Background: Triage for patients' prioritization in the emergency department is a suitable solution to decrease overcrowding. Different methods are used for prioritization that needs effectiveness evaluation.

Objectives: The aim of this study was to assess the effectiveness of the emergency severity index (ESI) 5-level triage system in contrast with spot check triage.

Patients and Methods: Data for this quasi-experimental study were extracted using a form to review 770 records of patients referred to emergency department of Imam Khomeini hospital (in Sari, north of Iran) during two separated periods each for four months; the first from 20th March to 19th July 2010 and the other from 21 March to 20 July 2011. The method used in the first time was spot check triage and the second one ESI triage. Data were processed with descriptive statistics and analyzed using independent samples t-test (CI = 95%).

Results: Increase from 6.46 to 8.92 minutes in the average time from patient arrival to being visited by a physician ($P < 0.001$) and increase in average time from physician visit to receive the first nursing care from 7.68 to 15.89 minutes were significant ($P < 0.001$). The average waiting time for laboratory services was significantly decreased from 112.3 to 84.1 ($P = 0.033$). Increase in the average waiting time for radiology, decrease in average waiting time for sonography, average length of stay in the emergency department, and number of patients per emergency bed were not significant.

Conclusions: Between the two systems of triage, ESI was more effective than the spot check and in the spatial and temporal domain of research, was a successful method in improving some indicators of emergency and improving the performance indices. Hospital managers by implementation of ESI system can take a step toward new health policies and improve the processes as key tools of continuous quality improvement system.

Keywords: Emergency Service, Triage, Comparative Effectiveness Research

1. Background

Nowadays, hospitals emergency departments are one of the most important departments in all health care system (1). Overcrowding in emergency departments is a problem that threatens patients' health (2); therefore, hospital triage is performed as an effective solution for solving this problem. Triage is defined as patients' prioritization regarding existent resources (3).

Increase in patients' workflow time in emergency department leads to more problems in other hospital wards and inter-department different processes (4), which can limit patients' access to cares (5). Kyriacou et al. (6) state that time studies are effective methods to identify delays in patient care and interventions should be aimed to reduce the length of stay in emergency. Many researchers seek to identify different ways for reducing waiting time in emergency department. For example, Ng et al. (7) stat-

ed that lean principles can facilitate patient flow in emergency departments and accordingly, patient satisfaction would be increased by reduction in service time. In another research, Spaite et al. (8) redesigned a rapid process for emergency department and resulted in decrease in waiting times and improvement in patients' satisfaction. Moreover, McGillicuddy et al. (9) tried to decrease the average time to be visited by a physician, the same as Paulson (10), which indicated a correlation between number of nurses and less waiting time.

On the other hand, triage system is used for communication between hospital personnel in emergency department and patients should be visited by a physician immediately (11). Thus, different methods for patient prioritization are used in emergency departments that vary in effectiveness. The emergency severity index (ESI) is a

five-level triage scale for prioritization (1 indicates most acute and 5 indicates least acute). The principle role of ESI is to facilitate prioritization of patients based on their urgency (12, 13).

ESI is recognized as a valid and accurate system, which prioritizes patients, as well as following their treatment process for better access to medical care and services (14). McHugh et al. (15) stated that ESI was the most commonly used triage system. ESI could be used in all emergency departments, including urban and rural settings and academic and community hospitals. Accordingly, Singer (16) reported high satisfaction rate among most emergency department professionals who used ESI.

Furthermore, Christ et al. (17) reported that triage instruments that sort patients in five levels were better than those in three levels regarding validity and reliability. Moreover, Durani et al. (18) reported ESI version 4 as a reliable tool for triage assessments in pediatric patients, which was highly accepted by physicians and nurses.

Thus, improvement in triage is the aim of hospitals to improve clinical outcomes, especially in resource-limited settings (19). Most of previous studies proved ESI as one of the best methods in patients' prioritization in many countries. In Iran, emergency departments provide services to about 30 million patients and improvement in its structure is one of the priorities in Iran ministry of health and medical education. In this way, using ESI triage in Iran hospitals is new and had not proved its effectiveness.

2. Objectives

Previous studies performed in other countries used time study, comparing different triage instruments, effects of triage system on communication between health personnel in emergency department to evaluate the triage methods. As well, ESI triage system is fairly new in Iran and administrative policy of the ministry of health and medical education of Iran is to remove spot check triage systems and replace ESI triage system in Iran. Since, the ESI effect on performance indicators has not been studied in Iran, a quasi-experimental study was performed to evaluate the effectiveness of ESI, version 4 triage method compared with spot check. The research aimed to identify strengths and weaknesses of ESI to help emergency department directors and staff to amend and improve internal processes in emergency departments.

3. Patients and Methods

This quasi-experimental study was performed to survey the effectiveness of ESI five-level triage system, version 4 compared with spot check in Imam Khomeini Hospital, Sari, north of Iran. The hospital is a governmental, educational and general center, which has 328 approved beds with 18 wards and serves as a referral hospital in Mazandaran Province.

Effectiveness analysis mainly focused on emergency departments' time indicators. Data about emergency department admission retrieved for two periods of time each for four months. The first period was from 20th March to 19th July 2010 and the second one from 21th March to 20th July 2011. In these two periods, two different triage systems were used in the emergency department. Three-level triage system was used in the first period named spot check with three levels including emergent, urgent, and not urgent. In the second period, comprehensive five-level triage system named ESI, version 4, was used with five levels.

Additionally, it would be important to account for potential differences in the patient population. We assessed patients' age and the average number of patients per emergency department bed to assure the similarity of two time periods. As well, we considered potential staff differences. This information for the two periods is presented in Tables 1 and 2.

Accordingly, the ESI and spot check were compared based on different time indicators including the average time to be visited by a physician, average time of delivering first nursing care, average time taken to receive the results of laboratory tests, average time taken to receive the report of radiology services, and average time taken to receive the report of sonography as dependent variables.

The study population included all patients triaged in emergency department of the hospital, which were about 6200 patients monthly. Krejcie and Morgan table was used to calculate sample size. Accordingly, a sample of 379 patients (20) was selected randomly for each period independently. To prevent loss of validity due to loss of sample, the sample size was multiplied by 1.02 and data were collected for 387 patients. For sampling, systematic random sampling was used to select the samples with sample interval of 16. However, 272 patients in the first period and 274 patients in the second period did not have medical record; because they were discharged after triage and there was no need to set up a medical record. Thus, the only record for them was triage form.

Data were extracted using data collection forms and filled based on patients' medical records. For reliability, data collection forms were prepared in the format of chronometry of emergency department services' workflow and instruction of indicators for hospital emergency department (1) without technical changes in the content and structure of the forms. Validity of checklist was approved using experts' opinion such as emergency medicine specialists and officials of emergency department of Imam Khomeini Hospital. Three emergency medicine specialists and one PhD educated in nursing participated in validating checklist. According to their comments, some fields were reformed and the final approved checklist was prepared. The checklist had two main parts of demographic characteristics of patients and service delivery in emergency department.

Extracted data were analyzed using SPSS software (11.5 by SPSS Inc.). Descriptive statistics such as frequency, mean, standard deviation and independent samples t-test were used for data analysis and the research confidence coefficient was determined at 95% level.

The study protocol complied with the ethical guidelines of the 1975 Declaration of Helsinki.

4. Results

From all 387 patients triaged with spot check (the first period), 63% were males and 37% females and from 383 patients of ESI (second period), 48% were males and 52% females. In addition, regarding patients' age in the two periods, triage services were delivered to similar patients (see Table 1 for comparing patients' age). As indicated in Table 1, mean of patients age in the first and second periods were around 35.7 and no significant difference was found ($P = 0.998$).

Similarly, we considered the average number of patients per emergency department bed and total number of triage nurses in the two periods. Table 2 shows no considerable differences in these two periods. According to observations, in the both periods, triage nurses were al-

most the same and no significant changes were made in manpower.

We also compared the number of patients categorized in different levels of triage. Since levels of two triage systems are not combinable, descriptive data are provided in Table 3.

Findings for time indicators are shown in Table 4. The average time of being visited by a physician was increased by 2.46 minutes, from 6.46 minutes in Spot check to 8.92 minutes in ESI ($P < 0.001$). The average time of delivering first nursing care reached from 7.68 minutes in spot check to 15.89 minutes in ESI, which increased by 8.21 minutes ($P < 0.001$). By reduction in the number of laboratory services in ESI compared to spot check, the mean time taken to receive the results of laboratory tests was decreased by 28.2 minutes, from 112.3 minutes in spot check to 84.1 minutes in ESI ($P = 0.033$). In addition to reduction in the number of radiological services in ESI compared to spot check, the mean time taken to receive the report of radiology services reached from 40.4 minutes to 44.9 minutes ($P = 0.644$). The mean time taken to receive the report of sonography decreased from 102.1 minutes in spot check to 63.4 minutes in ESI by 38.7 minutes reduction ($P = 0.171$).

Table 1. Comparison of Patients' Age in Three-Level Spot Check and Five-Level Emergency Severity Index Systems^a

Variable	Triage Systems		Test		
	Three-Level Triage Spot Check	Five-Level Triage ESI System	T	df	P
Age ^b	35.70 ± 20.668	35.74 ± 19.580	0.015	220	0.988

^aAbbreviations: df, degree of freedom; ESI, emergency severity index.

^bData are presented as mean ± SD.

Table 2. Comparison of Triage Man Power and Bed Indices in Three-Level Spot Check and Five-Level Emergency Severity Index Systems

Triage Systems	The Average Number of Patients per Emergency Department Bed	Number of Triage Nurse
Three-level triage spot check	0.42	7
Five-level Triage ESI system	0.38	7

Table 3. Categorization of Patients in Three-Level and Five-Level Systems^a

Levels	Spot Check Triage System			ESI Triage System				
	Emergent	Urgent	Not urgent	One	Two	Three	Four	Five
Number of patients	0	115	272	1	9	96	145	129

^aAbbreviation: ESI, emergency severity index.

Table 4. Comparison of the Time Indices in Three-Level Spot Check and Five-Level Emergency Severity Index Systems

Index	Three-Level Triage System Spot Check		Five-Level Triage ESI System		Test
	Frequency	Time, min ^a	Frequency	Time, min ^a	
The average time from patient arrival to being visited by a physician	387	6.46 ± 9.96	383	8.92 ± 9.66	T = -3.474, df = 768, P < 0.001
Time of delivering first nursing care	384	7.68 ± 9.357	114	15.89 ± 13.473	T = -6.085, df = 146.792, P < 0.001
Time taken to receive the result of laboratory test	77	112.3 ± 82.7	54	84.1 ± 66.3	T = 2.162, df = 126.618, P = 0.033
Time taken to receive the report of radiology services	43	40.4 ± 35.9	41	44.9 ± 51.7	T = -0.463, df = 82, P = 0.644
Time taken to receive the report of sonography as dependent variables	17	102.1 ± 71	17	63.4 ± 88.9	T = 1.4, df = 32, P = 0.171

^aValues are presented as mean ± SD.

5. Discussion

Two periods were relatively similar regarding admitted patients and service delivery. Therefore, we could conclude that change in triage system was one of the main factors affecting time indicators.

Based on findings about the average time to be visited by a physician, independent samples t-test showed a significant difference in the average time in the first and second periods; ESI Triage had a significant impact on time to be visited by a physician and had led to increase this index in the hospital. Other studies such as McGillicuddy et al. (9) and Ng et al. (7) investigations reported decrease in this index and our findings do not match with others. Maybe, start of new project and slow pace of learning ESI triage by nurses in hospital can be considered as influencing factors on this increase.

Similarly, average time of delivering first nursing care was increased significantly in ESI compared with spot check. This is also inconsistent with the results of other researches such as Azizi-Naghdlou (21) and Paulson (10). This may be because of misunderstanding about nursing care in spot check in the first period. Indeed, in spot check system in the first period, due to misperception among triage nurses and failure to identify the triage process, screening by nurses in the first place was considered as a kind of nursing care inconsistent with the standard definition of nursing care. While, changes in the triage system resulted in right registration time of nursing care requested by physician. In fact, reorganization of new processes and improving methods led to increasing this index and its actual occurrence.

Regarding the time of laboratory services, two independent samples t-test showed a significant difference in the average time before and after intervention (P = 0.033). Accordingly, ESI triage system led to reduction in this index

in hospital. This is in contrast with the result of Hosseini et al. (22), Eghdam et al. (23), and Storrow et al. (24). ESI triage system classifies patients with focus on their scale of severity, which facilitates patients flow in different levels and predicts the right required resources. On the other hand, ESI triage nurses act better in screening patients and lead them into the treatment process. As a result, about a half of patients in this emergency department with trauma who needed radiology and sonography procedures were led to these units and determining the real needs of patients for laboratory services, caused laboratory workload adjustment, and thus shorter waiting time and queue.

Average waiting time for radiology services was reduced in ESI, but independent samples t-test did not show any significant difference in the average time before and after intervention (P = 0.644). ESI Triage system was not effective on average time for radiology services. This finding is inconsistent with the results of Hosseini et al. (22) and Azizi-Naghdlou (21).

Another reduction was observed in the average time taken to receive the report of sonography. Nonetheless, independent samples t-test did not show any significant difference in the average time before and after intervention (P = 0.171). Therefore, ESI triage system was not effective on sonography services time. This is inconsistent with the results of Azizi-Naghdlou (21) and it seems that using a five-level triage system ESI represents a significant difference rate of index at two systems. Further inquiries revealed that number of sonography services for patients was equal in two periods. Minor and insignificant reduction in the index, perhaps is due to an increase in radiology specialist presence in radiology department, increase in the speed of service delivery or delivering emergency

sonography by emergency medicine specialists to improve treatment process.

Five-level triage system has been reported effective on emergency action consistent with Eghdam et al. (23) and Singer et al. (16) who reported that most experts in the emergency department believed that ESI led to more satisfaction and users found that ESI is more accurate than the other models and improve teamwork in triage. Besides, McHugh et al. (15) in a study on samples of more than 3000 hospital stated that ESI was the most commonly used triage system in hospitals.

Christ et al. (17) expressed that triage instruments with five levels have priority on three-level instruments regarding validity and reliability and only the ESI has been validated in German-speaking countries. Furthermore, Durani et al. (18) expressed that ESI version 4 is a triage system with high agreement between physicians and nurses and a reliable tool for triage assessments in pediatric patients, which is consistent with Paulson's (10) results as well.

In this paper we compared ESI triage system with spot check in an emergency department for the first time in Iran. Since ESI was new compared with spot check, maybe nurses, physicians and other staff were not enough familiar with ESI and it might overshadow the findings of the present research. Therefore, more researches in other times and other context are needed to generalize the results. Moreover, we compared these two systems regarding emergency department time indicators. We recommend more studies be performed about other aspects of emergency department process. Similarly, patients and staff satisfaction are factors that should be addressed comparing the two triage systems in future studies.

Between the two triage systems, ESI played a significant role to facilitate prioritization of patients according to their urgency situation and patient streaming; getting the right patient to the right resources at the right place and at the right time and acted more effective than three-level triage system spot check. Also, in the time and place domain of research has been a successful model on the effect of time indicators of emergency and promotion of some indices.

According to our findings, ESI triage system is more suitable for Iran than the three-level system. Emergency severity index could help hospital managers, since they are faced with limited resources and they should make the best use of these limited resources to make the best possible outputs. Emergency severity index triage system could decrease the average time of emergency department process and result in patient health and satisfaction. Hospitals and other medical centers are suggested to use ESI to help them take a step toward processes improvement as a key tool for continuous quality improvement.

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Footnotes

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