

Effect of Virtual Triage Training on the Accuracy of Triage of Emergency Nurses

Gholizadgougjehyaran H.*¹ *MSc*, Motaarefi H.¹ *PhD*, Sakhaei Sh.² *MSc*,
Ashrafi M.¹ *BSc*, Zinalpoor S.¹ *MSc*

¹ Department of Nursing, Khoy School of Medical Sciences and Health Services, Urmia University of Medical Sciences, Urmia, Iran

² Department of Internal Surgery Nursing, Khoy School of Medical Sciences and Health Services, Urmia University of Medical Sciences, Urmia, Iran

Abstract

Aims: Currently, one of the teaching methods in medicine and paramedical education is based on cyberspace. Due to its availability everywhere and all the time through the Internet, this method of education has become a useful and reliable tool, so this study aimed to determine the effect of virtual triage training on the accuracy of nurses' triage.

Instrument & Methods: This quasi-experimental study was conducted in 2020. The records of 350 patients referred to the emergency ward of Imam Khomeini and Qamar Bani Hashem hospitals of Khoy University of Medical Sciences in which the trial "Emergency Severity Index" triage had been actively implemented, was selected by simple random sampling. A questionnaire containing demographic information and a triage form based on the triage algorithm "Emergency deterioration index" was used to collect data. The triage form based on the triage algorithm "Emergency deterioration index" was filled by the researcher to diagnose triage error. The patient's triage level was determined. Then the triage level recorded by the triage nurse was compared with the triage level determined by the researcher. One month after implementing the training program, 350 patient files were reviewed by the researcher and the level of triage was determined, and the amount of triage error was checked. Data were compared by nonparametric Chi-square and McNemar tests.

Findings: The triage error decreased from 28% before the intervention to 19.1% ($p < 0.0001$). There was no statistically significant difference between demographic characteristics and triage error.

Conclusion: Giving the necessary knowledge to nurses, especially emergency nurses, causes the reduction of the amount of triage error.

Keywords

Triage [<https://www.ncbi.nlm.nih.gov/mesh/68014218>];
Triage Accuracy [Note Found];
Virtual Training [Note Found];
Emergency Nurses [Note Found]

*Corresponding Author

Tel: +98 (44) 36465260

Fax: +98 (44) 36465262

Post Address: Khoy School of Medical Sciences and Health Services, Urmia University of Medical Sciences, Shahid Montazeri Street, Urmia, Iran. Postal Code: 5816645533
h.gholizad1991@gmail.com

Received: October 8, 2021

Accepted: December 22, 2021

ePublished: January 15, 2022

Introduction

Overcrowding in the emergency department is a problem in the health care system and postpones the provision of care services to patients and increases the waiting time for receiving services, which subsequently affects patient satisfaction [1]. Also, a long stay in the emergency ward increases the casualties and costs caused by accidents and leads to violence in the hospital environment [2, 3]. Patients are classified based on the level, type, and severity of injuries according to the congestion level and available facilities in hospitals to provide care and treatment services to the patients based on the need for more and faster treatment, which is called triage [4].

Hospital triage services identify and prioritize patients who need emergency services first [5]. Triage is retrieved from the Latin word of Trier, which means prioritizing receiving medical and care services due to the crowds of clients and the lack of resources, facilities, and personnel to provide simultaneous services to patients [4-7]. In the 1950s, triage was introduced in the United States to solve the problem of congestion in hospital emergency departments. Since the early 1990s, several countries have designed triage systems. One of the triage systems is the Emergency Severity Index (ESI), developed in 1999 (first edition) by two emergency specialists named Richard Wuerz and David Eitel and revised four times so far. This system of triage is one of the five-level systems. Since the middle of 2006-2007, the Iranian health care system welcomed triage in five-level systems based on the urgency severity and was notified to all hospitals in the spring of 2011-2012 [8].

The triage task in the hospital is to identify and prioritize the patients who need to use emergency services first. Implementing ESI triage, like other triage systems, requires adequate levels of training and support. Without proper training in this field, nurses will not use triage correctly and follow the provided standards [9]. An accurate triage decision is the correct allocation of patients to receive emergency services at the best time according to the severity of their injuries [10].

Triage leveling has been classified into three categories of accurate triage assessment, including undertriage and over triage. As the improper determination of the patients at the undertriage level endangered them, especially patients waiting for a visit and treatment, the improper determination of the patients in the over triage level, make some consequences such as the use of limited financial and human resources in hospitals [11, 12]. Undoubtedly, nurses play a considerable role in the hospitalization duration of the patients and its reduction in the emergency ward through their professional practices, including patient triage [13, 14].

Mirage *et al.* [15], Kamrani *et al.* [6], Rahmani *et al.* [16] have reported the undertriage by 8.57, 23.7, and 12 respectively, and over triage by 48%, 11.7%, and 11.1%, respectively.

Proper triage for injured patients reduces mortality and improves resource utilization. For this purpose, the undertriage should be minimized, and conversely, high-level triage should be minimized to undertriage for the resources optimization [17]. Therefore, in addition to the triage system implementation and reducing its errors, its training is also important because today, education in medical and paramedical professions is significant [18]. Education is a factor of change and progress, which have a dramatic change and the development of education sciences and technologies. The old methods do not respond to the development of science and the changes in the needs of societies in today's electronic world [19, 20].

Today, one of the teaching methods in medicine and paramedical disciplines is virtual-based education. This type of training has advantages such as communication between trainer and learners, expansion, multimedia training content that uses text, voice, image, video, animation, simulation, etc. Therefore, virtual training is a reliable tool because of its availability everywhere and every time [21-23].

Limited research has been conducted on the prevalence of triage errors and the consequences of light and heavy triage in the emergency department in Iran, and the researchers observed this type of error in their work environment in the triage nurses in the emergency department. In addition, emergency department nursing managers need meaningful data to ensure the correct implementation of triage and identify nurses' need for training and deficiencies to adopt strategies to improve and enhance the triage quality and motivate them to perform triage properly. Since no research has been done on triage error in virtual education, this study aimed to investigate the effect of virtual triage training on the accuracy of triage of emergency nurses.

Instrument and Methods

This quasi-experimental single-group study was carried out on 25 triage nurses who worked in the emergency department of Imam Khomeini Hospital (n=12) and Qamar Bani-Hashem Hospital of Khoy University of Medical Sciences and Health Services (n=13) using pre-test and post-test methods. The samples were selected by the census method.

Inclusion criteria included being employed in the emergency department, not participating in triage training programs in the six months leading up to the research period, having at least a bachelor's degree in nursing, and at least two years of experience in the emergency department.

Inclusion criteria included being employed in the emergency department, not participating in triage training programs in the six months leading up to the research time, having at least a bachelor's degree in nursing, and at least two years of experience in the emergency department.

Exclusion criteria included not participating fully in the training program, transfer to other wards, and termination of service. A nurse was excluded from the study due to transfer to other wards. According to Morgan's table, among the records of the emergency wards of the two hospitals in September and October 2016 (3,500 cases), 350 cases were randomly selected. The triage algorithm and the emergency severity index were actively implemented on the subjects (175 records in Imam Khomeini Hospital and 175 in the Qamar Bani- Hashem Hospital).

The Nurses' Demographic Information Questionnaire, the Emergency Severity Index, and the researcher-made triage error checklist were used for data collection.

Data were collected after approving the research plan and obtaining the ethics license from Khoy University of Medical Sciences and Health Services. First, to diagnose triage error, the triage form was filled out based on the triage algorithm of emergency severity index by the researcher, who had a history of teaching triage courses and working in the emergency department as a triage nurse. Then the triage level of the patients was determined using the initial evaluation of the triage nurse and the first evaluation of the emergency physician recorded in the triage sheet and the patient file. Then, the level of triage recorded by the triage nurse was compared with the level of triage determined by the researcher. Then emergency severity index of triage was taught virtually to all selected nurses; the educational content included a training booklet, PowerPoint, and an audio file prepared from the fourth edition of the emergency severity index triage manual. The virtual training method was provided to the subjects by WhatsApp messenger. The educational materials were divided into four parts, and each part was uploaded to the group on a different day. First, the nurses had access to the material and used the training booklet, PowerPoint, and audio file whenever and wherever they wished; and in coordination with the nurses, group discussions began at 9-11 p.m. After the group discussion, the questions extracted from the fourth edition of the emergency severity index of triage were placed in a virtual environment to evaluate the nurses' learning. Learners could solve problems if they encountered a specific problem or question that they could not solve through the teacher's account. In addition, nurses were provided the links to sites related to the subjects to access and use reputable scientific sites and obtain the latest and comprehensive information. At the end of the four daily sessions, several scenarios were provided to the nurses for

learning consolidation. After two weeks, the training course ended. One month after the training, 350 patient records were re-examined by the researcher, and the triage level and error were determined. Pre-training data were compared with post-training data using nonparametric chi-square and McNemar's test.

Findings

66.7% of the subjects were female, and the mean age of nurses was 28.84 ± 7.49 years. There was no statistically significant relationship between demographic characteristics and triage error (Table 1).

Table 1) Demographic characteristics of triage nurses participating in the study (n=24)

Variable	Number (percentage)	
Gender	Male	8 (33.3)
	Female	16 (66.7)
Work experiences	<5	6 (25)
	5-10	5 (20.83)
	10-15	6 (25)
	15<	7 (29.17)
Experience as a triage nurse	1-2	7 (29.2)
	3-5	12 (50)
	5<	5 (20.8)

The 28% of triage error before the intervention (n=98) decreased to 19.1% after the intervention (n=67) ($p < 0.00001$). The highest triage error has occurred at level 3. Before the intervention, 38 cases (10.85%) were in the undertriage group, and 60 cases (17.15%) were in the over triage group. Triage error at different levels also decreased after the intervention (Table 2).

Table 2) Triage error rate at different levels of emergency severity index before and after intervention

Triage level	Before intervention	After intervention	Significance level
Level 1	3(0.9)	1(0.27)	p<0.00001
Level 2	27(7.7)	19(5.41)	
Level 3	50(14.3)	38(10.85)	
Level 4	18(5.1)	9(2.56)	
Level 5	0(0)	0(0)	

Discussion

The purpose of triage in the emergency department is to prioritize patient referrals for better management and provision of health care services, develop knowledge about patient prioritization, and allocate different levels to patients for nurses and physicians working in the emergency department. Knowledge about patient prioritization and assigning different triage levels to patients is essential for nurses and physicians working in the emergency department. Improper triage leads to loss of resources, delay in treatment of patients, their dissatisfaction, and adverse consequences. Proper triage can be useful in determining the treatment and

facilitating the process of stabilizing the condition of patients and their admission [24, 25].

The results showed that after the virtual educational intervention, the triage error decreased, and the level of the over triage was more than the undertriage. The over triage is tolerable for some patients whose lives are not endangered. However, the optimal use of emergency resources may be impaired, and the optimal use of other patients in the emergency department may be disrupted. On the other hand, allocating the undertriage to the patient causes a person's health status to be endangered due to longer waiting times. According to studies, emergency departments' acceptable undertriage rate is less than 10% [26, 27].

Brosinski *et al.*, in a study aimed to improve the accuracy of triage, resulted that the rate of the undertriage before training was 26.3%, which was reduced to 9.3% after the training, and the total rate of triage error was reduced [28]. Ebrahimi *et al.* investigated the effect of triage training on triage nurses and emergency medical staff performance. They found that the rate of triage error before training was 57.7 and 64.1%, which decreased by 7.7% and 23.1% after training, respectively [29]. In a study by Zamanpour *et al.*, the mean of light triage before intervention decreased from 2.43 ± 4.37 to 2.06 ± 2.66 one month after ESI triage training. Also, the over-triage decreased from 1.86 ± 4.30 to 1.99 ± 3.17 one month after training, which was statistically significant ($p < 0.001$) and was consistent with the present study [30].

In the study by Jordi *et al.*, the correct triage rate was 59.6%. The undertriage rate was 26.8%, and the over triage rate was 13.6% [31] which was inconsistent with this study. In the present study, over triage was more than undertriage. Also, the results of Jordi *et al.* [31] showed no statistically significant difference between demographic characteristics and the rate of triage error, which was consistent with this study. In the study by Mystery *et al.* aimed to investigate the accuracy and reliability of ESI triage, the results showed no statistically significant difference between work experience and the accuracy of triage [32]. However, in the study of Rahmani *et al.*, gender had a decisive role in the rate of triage error, and a significant difference was observed between the correct triage performed by female nurses compared to men ($p = 0.003$). The accuracy of triage performed by female nurses was higher [16].

Due to the nature of the research, the lack of accurate recording of information by the triage nurse was one of the limitations that the researcher could not control.

Conclusion

Considering the unfavorable results of triage error, it is possible to reduce the rate of triage error using this study's results and provide the necessary

information to nurses, especially emergency nurses. Also, the adverse consequences of the undertriage can be reduced considering the results of this research in nursing students' courses and emphasizing their accuracy as much as possible.

Acknowledgments: We would like to thank the officials and staff of the hospital of Qamar Bani-Hashem and Imam Khomeini Khoy Hospital and all the participants who helped us in this project.

Ethical Permissions: This article has been approved with the ethical code IR.KHOY.REC.1399.010 in Khoy University of Medical Sciences and Health Services.

Conflicts of Interests: No cases have been reported by the authors.

Authors' Contribution: Gholizadgougjehyaran H (First Author), Introduction Writer/Methodologist/Main Researcher/Statistical Analyst/Discussion Writer (20%); Motaarefi H (Second Author), Methodologist/Main Researcher/Statistical Analyst (20%); Sakhaei Sh (Third Author), Assistant Researcher/Statistical Analyst (20%); Ashrafi M (Fourth Author), Introduction Writer/Assistant Researcher/Discussion Writer (20%); Zinalpoor S (Fifth Author), Assistant Researcher/Discussion Writer (20%)

Funding/Support: This research was carried out with the Vice-Chancellor for Education and of Khoy University of Medical Sciences and Health Services.

References

- 1- Abir M, Goldstick JE, Malsberger R, Williams A, Bauhoff S, Parekh VI, et al. Evaluating the impact of emergency department crowding on disposition patterns and outcomes of discharged patients. *Int J Emerg Med.* 2019;12(1):4.
- 2- Davis Z, Zobel CW, Khansa L, Glick RE. Emergency department resilience to disaster-level overcrowding: A component resilience framework for analysis and predictive modeling. *J Op Manag.* 2020;66(1-2):54-66.
- 3- Akbari M, TAHERI L, MOMENIYAN S, NADERI L. Time indices and its related factors in the emergency department of teaching hospitals affiliated to Qom University of Medical Sciences, 2017. *Iran J Emergency Care.* 2017;1(3):48-58. [Persian]
- 4- Asgari H, Omidi MR, Omidi N. Evaluating the Disaster Triage Knowledge of Nurses Personnel in Public Hospitals of Ilam. *Health in Emerg Disaster.* 2018;4(1):37-42.
- 5- Stanfield LM. Clinical decision making in triage: An integrative review. *J Emerg Nurs.* 2015;41(5):396-403.
- 6- Kamrani F, Ghaemipour F, Nikravan M, Alavi Majd H. Prevalence of miss triage and outcomes under triage of patients in emergency department. *J Health Promot Manag.* 2013;2(3):17-23. [Persian]
- 7- Yarmohammadian MH, Rezaei F, Haghshenas A, Tavakoli N. Overcrowding in emergency departments: a review of strategies to decrease future challenges. *J Res Med Sci.* 2017;22:23.
- 8- Wachtel G, Elalouf A. Addressing overcrowding in an emergency department: an approach for identifying and treating influential factors and a real-life application. *Israel J Health Policy Res.* 2020;9(1):1-12.
- 9- Safari S, Rahmati F, Baratloo A, Motamedi M, Forouzanfar MM, Hashemi B, et al. Hospital and pre-hospital triage systems in disaster and normal conditions: A review article. *Iran J Emerg Med.* 2015;2(1):2-10.

- 10- Dolan B, Holt L. *Accident & Emergency: Theory into practice*. 3rd Edition. Amsterdam: Elsevier Health Sciences; 2013.
- 11- Rahmati H, Azmoon M, Meibodi MK, Zare N. Effects of triage education on knowledge, practice and qualitative index of emergency room staff: A quasi-interventional study. *Bull Emerg Trauma*. 2013;1(2):69-75.
- 12- Kuriyama A, Urushidani S, Nakayama T. Five-level emergency triage systems: variation in assessment of validity. *Emerg Med J*. 2017;34(11):703-10.
- 13- Hileman E, McKain D. *Implementation of emergency severity index training to improve accuracy of triage levels [dissertation]*. United States: Southern Illinois University Edwardsville; 2019.
- 14- Singer RF, Infante AA, Oppenheimer CC, West CA, Siegel B. The use of and satisfaction with the Emergency Severity Index. *J Emerg Nurs*. 2012;38(2):120-6.
- 15- Mirhaghi AH, Roudbari M. A survey of emergency department nurses on hospital triage. *Iran J Crit Care Nurs*. 2011;3(4):165-70. [Persian]
- 16- Rahmani F, Sepehri Majd P, Ebrahimi Bakhtavar H, Rahmani F. Evaluating the accuracy of emergency nurses in correct triage using emergency severity index triage in Sina hospital of Tabriz: a cross-sectional analysis. *J Emerg Pract Trauma*. 2018;4(1):9-13.
- 17- Verelst S, Wouters P, Gillet J-B, Van den Berghe G. Emergency department crowding in relation to in-hospital adverse medical events: a large prospective observational cohort study. *J Emerg Med*. 2015;49(6):949-61.
- 18- Khatiban M, Khazaei A, Karampourian A, Soltanian A, Kimiaie AH, Salimi R, et al. The effects of the emergency severity index triage education via problem-based learning on the triage nurses' performance and the patients' length of stay in the emergency department. *J Clin Res Paramed Sci*. 2014;3(2):63-74. [Persian]
- 19- Banks JA. *Civic Education for Non-Citizen and Citizen Students*. England, UK: Routledge; 2020. P. 198.
- 20- Faheim SS, Ahmed SS, Aly EF, Hegazy SM. Effect of triage education on nurses' performance in diverse emergency departments. *Evid Nurs Res*. 2019;1(2):53-63.
- 21- Kadivar M, Seyed Fatemi N, Zolfaghari M, Mehran A, Azizkhani I. The Effect of Virtual Education on Neonatal Nurses' Caring Ability at the Neonatal Intensive Care Unit. *Iran J Pediatr Nurs*. 2017;3(3):32-9. [Persian]
- 22- Fealy S, Jones D, Hutton A, Graham K, McNeill L, Sweet L, et al. The integration of immersive virtual reality in tertiary nursing and midwifery education: A scoping review. *Nurse education today*. 2019;79:14-9.
- 23- Habibzadeh H, Rahmani A, Rahimi B, Rezai SA, Aghakhani N, Hosseinzadegan F. Comparative study of virtual and traditional teaching methods on the interpretation of cardiac dysrhythmia in nursing students. *J Educ Health Promot*. 2019;8:202.
- 24- Fernandes CM, Tanabe P, Gilboy N, Johnson LA, McNair RS, Rosenau AM, et al. Five-level triage: A report from the ACEP/ENA Five-level triage task force. *J Emerg Nurs*. 2005;31(1):39-50.
- 25- Rehn M, Eken T, Krüger AJ, Steen PA, Skaga NO, Lossius HM. Precision of field triage in patients brought to a trauma centre after introducing trauma team activation guidelines. *Scand J Trauma Resusc Emerg Med*. 2009;17(1):1-17.
- 26- Grossmann FF, Zumbrunn T, Ciprian S, Stephan FP, Woy N, Bingisser R, et al. Undertriage in older emergency department patients—tilting against windmills?. *PLoS one*. 2014;9(8):e106203.
- 27- Yurkova I, Wolf L. Under-triage as a significant factor affecting transfer time between the emergency department and the intensive care unit. *J Emerg Nurs*. 2011;37(5):491-6.
- 28- Brosinski CM, Riddell AJ, Valdez S. Improving triage accuracy: A staff development approach. *Clin Nurs Spec*. 2017;31(3):145-8.
- 29- Ebrahimi M, Ghanbarzahi N, Gorgich ZG, Darban F, Shirzadi F. The effect of triage training on the performance of triage nurses and emergency medical staff of Iranshahr. *Int J Med Res Health Sci*. 2016;5(9):190-6.
- 30- Zamanpour M, Ebrahimbakhtavar H, Parsian Z, Abdollahi F, Rahmani F. The effect of the emergency severity index triage training on the knowledge and decision-making of the medical interns. *J Res Clin Med*. 2020;8(1):13.
- 31- Jordi K, Grossmann F, Gaddis GM, Cignacco E, Denhaerynck K, Schwendimann R, et al. Nurses' accuracy and self-perceived ability using the Emergency Severity Index triage tool: a cross-sectional study in four Swiss hospitals. *Scand J Trauma Resusc Emerg Med*. 2015;23(1):62.
- 32- Mistry B, De Ramirez SS, Kelen G, Schmitz PS, Balhara KS, Levin S, et al. Accuracy and reliability of emergency department triage using the emergency severity index: an international multicenter assessment. *Ann Emerg Med*. 2018;71(5):581-7.e3.