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A time and motion study in pediatric ER of the Secondary Hospital in Al Jouf Region, Saudi Arabia

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Abstract. – OBJECTIVE: In the hospital setting, long waiting times and the lengthy formal process have increased the inefficiency and mismanagement resulting in the missing chance of saving the patient's life. Our aim was to assess the time wastage of every patient coming from reception to the actual emergency unit, to analyze the factor associated with the time lapse that occurs during every visit, and to see the effect of training on the services provided in the Pediatric emergency room.

SUBJECTS AND METHODS: An intervention study was carried out in the following secondary care hospital in the Al Jouf region, Saudi Arabia: Esawiyah Hospital, Haditha Hospital, King Faisal Hospital, and Gurayat General Hospital among 400 study participants for 12 months. The study was carried out in 2 phases: pre-training, a period of training for hospital staff, and post-training data collection. Templates were generated on an MS Excel sheet and analysis of data was done using SPSS software. Percentages and proportions were calculated for descriptive statistics.

RESULTS: Male and female patients were in the ratio of nearly 1:1. Training has significantly reduced the time to doctor consultation (U = 188, $p < 0.001$), and the time difference pre- and post-training from triage to consultation in a pediatric emergency is not significant (U = 16,769, $p = 0.01$). There is a strongly significant association ($p < 0.001$) between Canadian Triage and Acuity Scale (CTAS) implementation in triage. The practice of giving intravenous (IV) antibiotics in the emergency room has reduced significantly ($p < 0.001$) post-training.

CONCLUSIONS: Training has a significant impact on the services provided in the pediatric emergency room.

Key Words:
Time, Motion, Pediatric, Emergency room, Gurayat, Aljouf.

Introduction

A method for increasing corporate efficiency is time and motion analysis. Time motion studies entail gathering information on how long it takes to complete a certain action or task. In the end, these studies are conducted to increase productivity at a particular workplace, and especially in a hospital, these studies[1] may help foster more effective working interactions between hospital staff and their patients. The goal of a time-motion study in a healthcare facility is to determine the length of time required at various service delivery points in the outpatient department (OPD) for a given activity, job function, or mechanical procedure, as well as to gauge beneficiaries' perceptions of the OPD's overall length of stay[2]. Within the hospital system, patients are hosted in a variety of outpatient facilities, but virtually always a sizable portion of these patients enter and leave at various times. One element that impacts the use of health care services is the length of time a patient must wait to be seen[3], and patients view lengthy wait times as obstacles to receive services[4]. The overall length of time spent in the medical institution before obtaining the actual service is known as the patient waiting time. Previous studies[4,5] have shown that patients who wait longer than two to

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four hours become dissatisfied and do not follow treatment programs. The outcomes of patients and their waiting times can be used to evaluate critically the quality and efficacy of treatment in emergency rooms. Additionally, there is a strong correlation between a long waiting time and patient discontent[5]. Longer waiting times cause patients to seek out alternative medical facilities, which causes them to become even more disorganized and lose the window of opportunity for a better outcome. In the emergency room (ER), the prompt treatment enhances patient outcomes and may even save lives[6].

The care of patients who arrive at the emergency department (ED) in unpredictable and dynamic stages of illness, handling uncertainties surrounding patients' medical histories, and the requirement for time-sensitive and triage-based decision-making present special challenges to ED staff. All of these frequently come with a burden to be economically efficient and large financial expenditures to healthcare systems[7]. Crowding is one of the most prevalent ED weak points, so it is critical to comprehend its sources, impacts, and mitigation measures. The capacity of EDs to manage and offer quick access and stabilization for patients who have an emergency medical condition is reduced by overcrowding[8]. Several factors, such as the patient's features, the need for additional examinations, such as radiological investigations and laboratory testing, the requirement for sedation or specific treatments, and the length of the hospitalization process, affect how long a patient stays in the hospital[9-15].

This study was conducted to evaluate the waiting time as well as to calculate the time lapse in reaching the pediatric emergency to receive the service and to assess patient satisfaction because the quality of care and length of stay at the emergency department are influenced by the patient's waiting time. The need of this study is to track the time wastage, link the associated factors and create further improvement by imparting training to the hospital staff.

Subjects and Methods

An intervention study was conducted in 4 secondary care hospitals in the Al Jouf region, Saudi Arabia namely Esawiyah Hospital, Haditha Hospital, King Faisal Hospital, and Guryat General Hospital for a total duration of 12 months from the date of the ethical approval. All the patients attending the pediatric emergency room of the abovementioned hospitals, and those who gave consent to participate in the study were included in the study while all those who were critically ill and patients in deep agony were excluded from the study. The total sample size achieved was 400. The sampling technique used was total consecutive sampling. The study was carried out in 2 phases: pre-training and post-training. A pretested semi-structured questionnaire containing the following sections: socio-demographic details, the reason for attending the hospital and the average time required for consultation, the reason for the delay according to them, and questions regarding patient satisfaction from the consultation was used as the tool for the study. After preliminary data collection, training was given to hospital staff on the modalities to reduce patient consultation time upon reaching the hospital based on the response of the patient in the pre-training phase. Before starting with the interview as a part of data collection, the guardian or attendant of the patient explained the study and informed written consent was taken from them. After the training, patients were again assessed for improvement in the time-lapse. Ethical approval for the study was taken from the Institutional Ethics Committee and Administrative approval was taken from Guryat General Hospital, Saudi Arabia.

Statistical Analysis

Templates for data entry were generated in an MS Excel sheet and analysis of data was done using SPSS software version 20 (IBM Corp., Armonk, NY, USA). Percentages and proportions were calculated for descriptive statistics. Time was noted with the help of a digital stopwatch and detected at every station by an observer with the help of the same watch. The time difference was calculated and analyzed for every station. Mann-Whitney test was applied to know the difference for pre and post variables. p-value < 0.05 was considered statistically significant.

Results

At the end of the study done in the Pediatric emergency room to assess the waiting time and calculate the time lapse in reaching the pediatric emergency room and avail of the services, in the

Table I. Sex distribution and visit type (N = 400).

Variable	Categories	Pre	Post	Total
Sex	Male	102 (51.0%)	97 (48.5%)	199 (49.8%)
	Female	98 (49.0%)	103 (51.5%)	201 (50.3%)
Type of Visit	First Visit	200 (100.0%)	200 (100.0%)	400 (100.0%)
	Follow-up	–	–	–

pre- and post-training phase, it can be seen in Table I that out of total 400 study participants, 200 were taken during pre-training phase and another 200 were taken during the post-training phase. Male and female patients were in a ratio of nearly 1:1, 199 out of 400 (49.8%) were males whereas 201 out of 400 (50.3%) were females and for all the study participants, this was the first visit to the emergency room (Table I).

Table II depicts that there is a significant difference in the scores pre- and post-training for variables such as time from registration to triage as well as time to doctor consultation. This implies that training has significantly reduced the time to doctor consultation (U = 188, *p*-value < 0.001) whereas the Mann-Whitney U test shows that the time difference pre- and post-training from triage to consultation in a pediatric emergency is not significant (U = 16,769, *p*-value = 0.01). The range of age for both the groups, pre- and post-training are similar except that, for the post-training group, the median age of study participants is 4 years while it is 3 years for the pre-training group (Figure 1). Figure 2 reflects that the median duration from registration to patient triage is lesser for the post-training group as compared to the pre-training group with multiple extreme outliers present in both groups meaning that more time was required for many patients in both groups. A much larger duration was required for doctor consultation in the post-training group as compared to the pre-training group as can be seen in Figure 3. Figure 4 depicts that the median duration of doctor consultation was almost negligible for the post-training group.

Table III and Figure 5 depict the comparison of pre- and post-training groups between multiple variables, and it is seen that the availability of pediatric specialist in the emergency department during the visit has significantly increased (*p*-value < 0.001) as compared to the pre-training availability. There is a strongly significant association

Table II. Pre and post comparison.

Variable		Mean±SD	Min	Max	Median (IQR)	Mann-Whitney U	*p*-value
Age (Years)	Pre	4.22±3.58	0.2	13	3.00 (1.00-6.00)	19,971	0.98
	Post	4.13±3.27	0.2	13	4.00 (1.00-6.00)		
Time from registration to triage **(Hr: Min)**	Pre	0:07+0:08	0:00	1:09	0:05 (0:02-0:08)	10,995	<0.001
	Post	0:05+0:10	0:00	1:01	0:01 (0:00-0:05)		
Time from triage to doctor consultation in Pediatric Emergency **(Hr: Min)**	Pre	0:11+0:11	0:01	2:02	0:08 (0:05-0:14)	16,769	0.01
	Post	0:10+0:11	0:00	1:07	0:06 (0:04-0:11)		
Time to doctor consultation **(Hr: Min)**	Pre	0:20+0:09	0:00	1:24	0:19 (0:14-0:24)	188	<0.001
	Post	0:01+0:01	0:00	0:15	0:00 (0:00-0:00)		

QR: Interquartile Range, SD: Standard deviation.

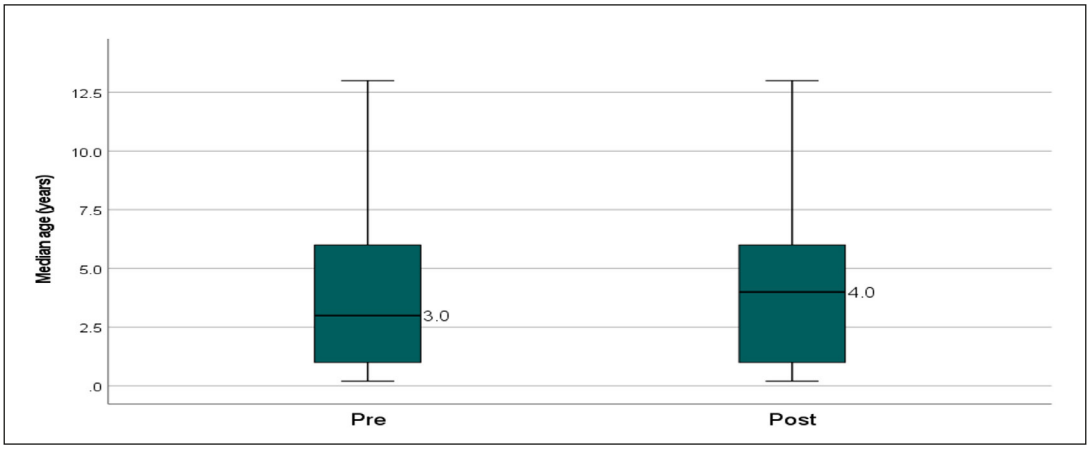

Figure 1. Pre- and post-training age group comparison.

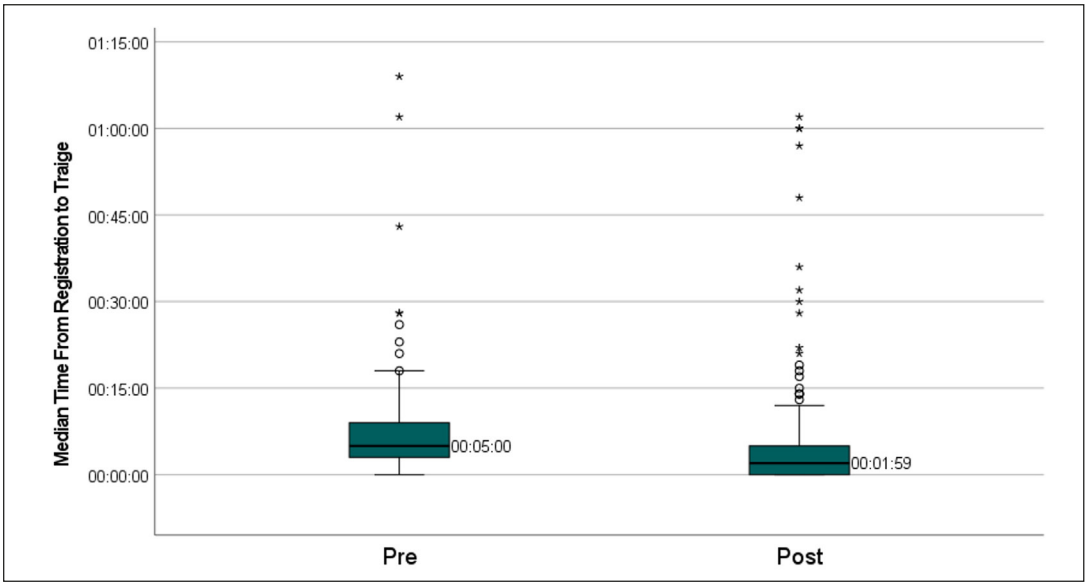

Figure 2. Median duration from the registration of the patient to the triage.

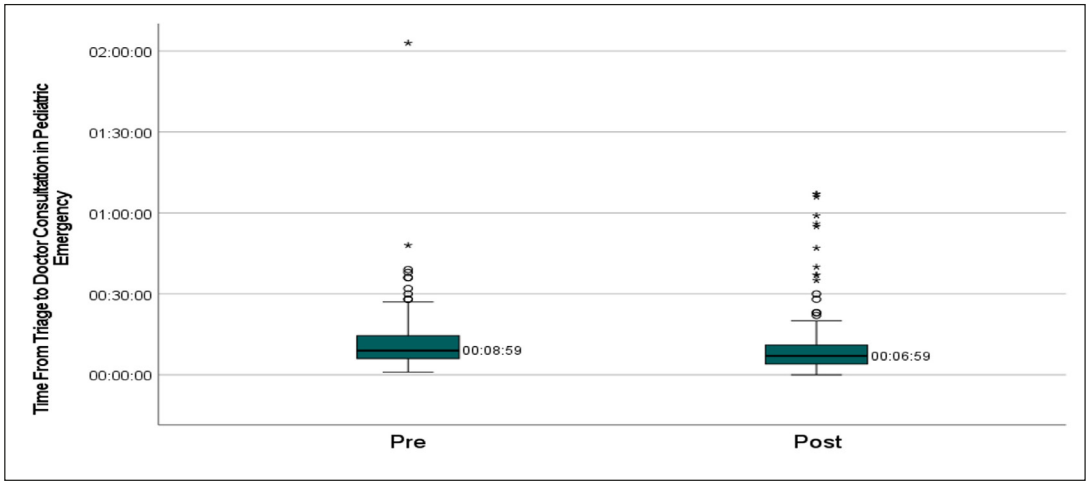

Figure 3. Median duration from triaging to doctor consultation in Pediatric Emergency.

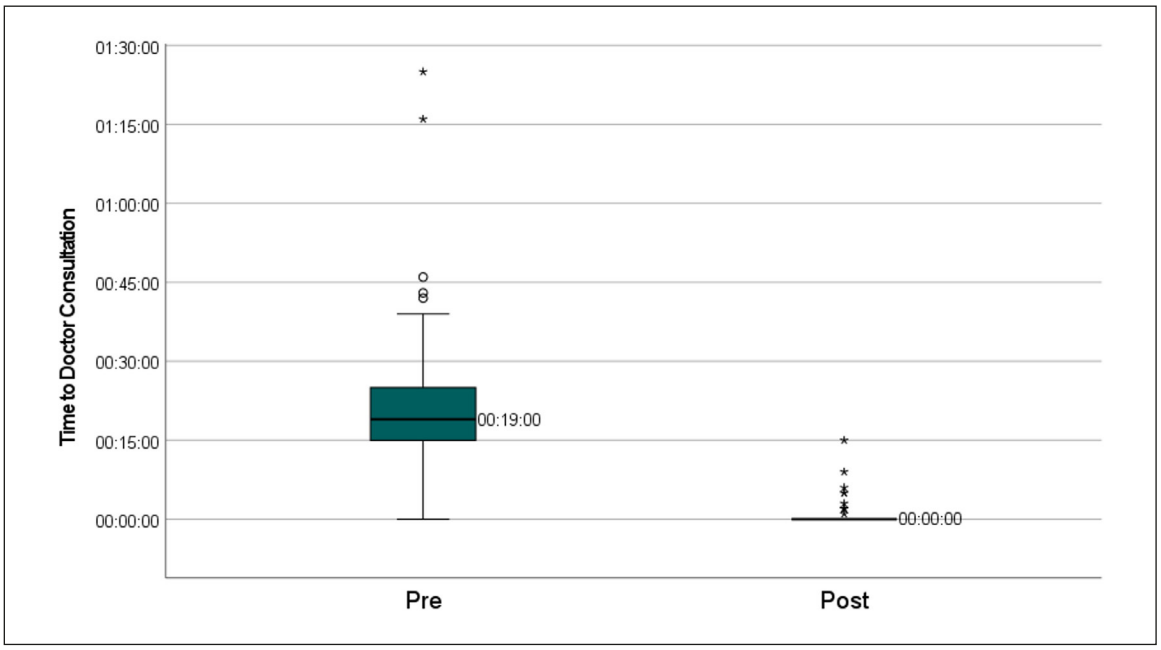

Figure 4. Median duration for doctor consultation.

(p-value < 0.001) between CTAS implementation in triage and training as there is 100% implementation of CTAS post-training.

Variables that have significantly improved (p-value < 0.001) post-training are the availability of blood culture vials in the pediatric ER, ready nebulization room, availability of two nurses in the pediatric ER during all shifts, and one nurse stationed in the nebulization room, and availability of pediatric improvement group whereas the practice of giving IV antibiotics in the emergency room has reduced significantly (p-value < 0.001) post-training.

Discussion

The patient waiting time in a hospital depends on many factors and, if a proper study is done, it can detect the factors, thus the waiting time can be significantly reduced. It can also be decreased by simple measures as done in the current study. It was found that patient waiting time in the post-test period decreased and it was found to be significant. In a study conducted by Umar et al[16] a total of 118 patients (31%) spent less than an hour in the waiting room, whereas 371 (96.6%) only saw their doctor for less than 30 minutes. Only 63 (16%) of the respondents acknowledged receiving health discussions while they were waiting to see a doctor, but 211 (55%) of the respondents were happy with the Hospital's service delivery. More than half of the patients were satisfied with the services provided to them, even though the bulk of them had to wait more than an hour[16].

In a related study by Li et al[17], it was discovered that 29,035 kids overall attended the pediatric ER during the study period. 61% of all visits were brought on by complaints of fever. 74.3% of visits had length of stays (LOSs) less than 2 hours, while the mean LOS was 2.6 to 4.67 hours. To create a total of nine patient subgroups, the classification and regression tree (CART) analysis chose five variables (waiting time for hospitalization, laboratory testing, door-to-physician time, gastrointestinal symptoms, and patient outcome). The validation dataset's mean LOS and the model building dataset's mean LOS have a strong correlation (r^2=0.999). In their study, Nassar et al[18] discovered that the mean age of the cases they looked at was 3.62 years, with ages ranging from 1 month to 12 years. 53.4% of patients were females. In the current study, 43.8% of the patients were released from the Emergency Department. According to this study, 71.8% of the cases examined visited hospitals between 9 a.m. and 9 p.m. There was no sex- or length-related difference that was statistically significant. In the current

Table III. Pre- and post-training comparison.

Variable		Pre	Post	Total	Chi-Square, *p*-value
Admit patient					
	No	200 (100%)	161 (80.5%)	361 (90.3%)	43.213, <0.001
	Yes	0 (0.0%)	39 (19.5%)	39 (9.8%)	
Availability of Pediatric specialist at emergency department during visit					
	No	200 (100%)	3 (1.5%)	203 (50.8%)	388.177, <0.001
	Yes	0 (0.0%)	197 (98.5%)	197 (49.3%)	
CTAS implemented in triage					
	No	200 (100%)	0 (0.0%)	200 (50.0%)	400.000, <0.001
	Yes	0 (0.0%)	200 (100%)	200 (50.0%)	
IV antibiotics are given in the ER					
	No	200 (100%)	141 (70.5%)	341 (85.3%)	69.208, <0.001
	Yes	0 (0.0%)	59 (29.5%)	59 (14.8%)	
Ready Nebulization room					
	No	200 (100%)	1 (0.5%)	201 (50.3%)	396.020, <0.001
	Yes	0 (0.0%)	199 (99.5%)	199 (49.8%)	
Availability of blood culture vials in pediatric ER					
	No	200 (100%)	5 (2.5%)	205 (51.3%)	380.488, <0.001
	Yes	0 (0.0%)	195 (97.5%)	195 (48.8%)	
Time recorded for blood sample collection					
	No	200 (100%)	1 (0.5%)	201 (50.3%)	396.020, <0.001
	Yes	0 (0.0%)	199 (99.5%)	199 (49.8%)	
Availability of 2 nurses in the pediatric ER during all shifts					
	No	200 (100%)	2 (1.0%)	202 (50.5%)	392.079, <0.001
	Yes	0 (0.0%)	198 (99.0%)	198 (49.5%)	
Availability of 1 nurse stationed in the nebulization room					
	No	200 (100%)	13 (6.5%)	213 (53.3%)	351.174, <0.001
	Yes	0 (0.0%)	187 (93.5%)	187 (46.8%)	
Availability of Pediatric improvement group					
	No	200 (100%)	0 (0.0%)	200 (50.0%)	400.000, <0.001
	Yes	0 (0.0%)	200 (100%)	200 (50.0%)	

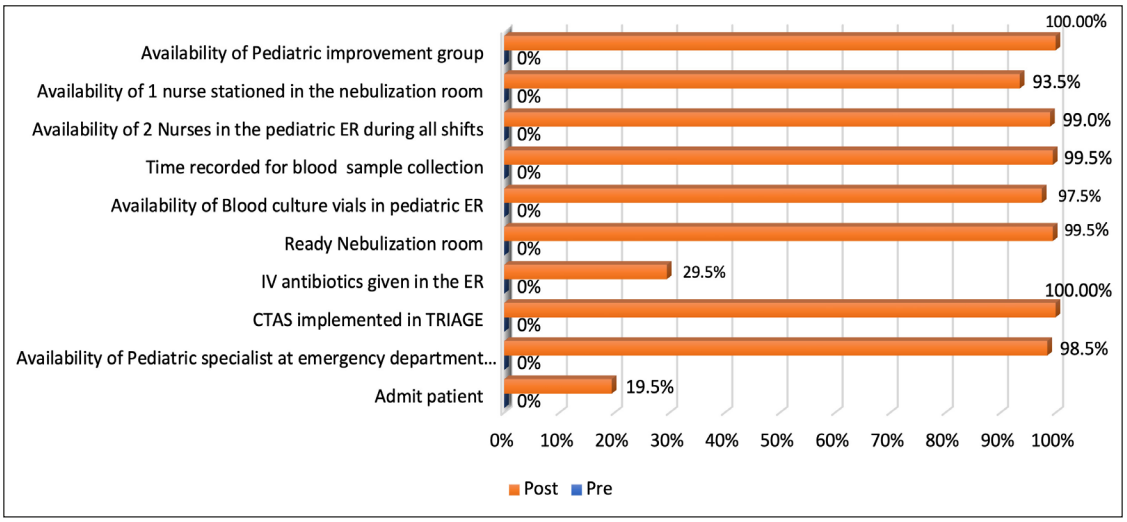

Figure 5. Pre- and post-comparison.

study, discharged patients' mean length of stay (hours) was lower (0.20 to 0.59) than that of admitted patients (0.51 to 0.58).

In a different study, conducted by Yen et al[19] it was discovered that median computer time for attending physicians increased from 5.0 minutes before computer physician order entry to 9.5 minutes following it (p-value = .01). For resident doctors, the median amount of time spent on the computer increased from 5.5 minutes before computer physician order entry to 14.3 minutes afterward (p-value = .001). Although there may have still been some shift in time allocation, the amount of time spent on the computer by nurses before and after computer physician order submission was not substantially different (p-value = .15). Nurses' conversations with staff on patient care fell from 24.5 minutes to 13.3 minutes (p-value = .01) after computerized physician order entry. None of the caregiver categories saw a reduction in patient contact time as a result of computerized physician order entry. According to research by Hemmati et al[20] variables including high patient volume, the distance between emergency rooms, ineffective communication, and low staffing levels contribute to the lengthy wait times for patients. Additionally, the findings revealed a strong correlation between the patient waiting time and the working shift, the day of the visit, and insurance coverage (p-value = 0.05). According Chopade et al[2], the average study time was too long for 26.67% of the participants. A total of 26% of study participants were dissatisfied with the amount of time spent in the OPD, compared to a total satisfaction rate of 50.34%.

Conclusions

It can be concluded from the study that training the hospital staff about the techniques to reduce the waiting time of patients worked well enough to achieve the results. Training also showed a reduction in IV antibiotics use in the Emergency Room. Similar studies can be done to achieve decreased waiting times for patients in hospitals or emergency rooms. Training about triage in the emergency room can also help in the reduction waiting time for patients.

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Conflict of Interests
The authors declare that they have no conflict of interests.

Ethics Approval
Ethics approval for the study was given by the Institutional Ethical Review Committee, AlGuryat Gerenal Hospital, Aljouf, Saudi Arabia and Administrative approval was ob tained by Guryat General Hospital.

Informed Consent
Informed written consent was obtained from the participants included in this study.

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