



Utilization of an Electronic Triage System by Emergency Department Nurses

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Introduction: Emergency departments use triage systems to prioritize patients according to the severity of their condition. The Electronic Canadian Triage and Acuity Scale (E-CTAS) is a popular system that categorizes patients into five levels to manage patient flow and prioritize patient access to health-care services.

Methods: We assessed the factors that influence E-CTAS usage in emergency departments in Eastern Saudi Arabia. Seventy-one nurses were included from two emergency departments that adopted E-CTAS. We used the technology acceptance model (TAM) to assess the influencing factors. The TAM was reliable in the study setting (Cronbach's $\alpha = 0.87$).

Results: All of the TAM domains were significantly related to the usage of E-CTAS: perceived ease of use, perceived usefulness, importance of training, social influence, behavior intention, and attitude. We also showed that E-CTAS use significantly increased with years of experience and training.

Discussion: Many factors influenced the use of this electronic triage system. Focusing on these factors in future electronic triage system implementations might increase the hospital staff's compliance, thus improving accuracy and better organizing the patient flow in emergency departments.

Keywords: emergency department, electronic triage, nurse, technology acceptance model, TAM, the Canadian Triage and Acuity Scale, CTAS, Transformation Program 2020, triage

Introduction

The emergency department is a vital part of any hospital that operates 24 hrs a day, 7 days a week. Emergency departments provide critical medical treatment for those who do not have appointments and need immediate care. Hospitals admit many patients through the emergency department, either by ambulance or by their means. Emergency department admission gives the department a critical role in providing treatment for a large segment of injuries and diseases in a timely manner. Due to the variation in cases and severity levels, overcrowding is the main issue facing emergency departments at many hospitals.

Triage directly influences an emergency department's performance. It is an active process in which patients are prioritized according to the acuity of their conditions.¹ In the last 20 years, the triage system has been unified in various nations, and endeavors have made to guarantee consistent use.² Numerous triage instruments are in use around the world, including the Canadian Triage and Acuity Scale (CTAS), the Manchester Triage System, the Australasian Triage Scale, and the Emergency Severity Index.³

The CTAS is one of the most popular triage systems in the world. It uses five levels to prioritize patients in an emergency department, organize the flow of

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patients in the hospital, and distribute the workload.⁴ The CTAS is based on a comprehensive list of patient complaints, which are used to ascertain the triage level.⁴

The triage process has been automated using electronic triage systems. An Electronic Triage System (ETS) is used for auxiliary services such as supplying authorized persons with quick reports.⁵ Reports can include the number of emergency patients at specific times, in which the total number of visitors can be presented for each triage category, and the length of triage (ie, how long each triage process took). Government hospitals provide free services, which makes them overcrowded. An ETS benefits a government hospital by decreasing and organizing the crowding.⁶

It is important to note that, to the authors' knowledge, none of the hospitals that currently adopt the use of ETSs mandate its use by the hospital staff. Thus, this leaves the decision to use the tool depends entirely on the users.

Based on the literature, there is a resistance to technology adoption in Saudi Arabia.⁷ Our aim is to investigate the factors behind nurses' resistance to using E-CTAS. According to the Saudi National Transformation Program 2020, this study contributes to improving Saudi health-care services by providing methods to ease access to emergency medical care.

Methods

This cross-sectional study was conducted in King Fahad University Hospital and Dammam Medical Complex, in Eastern Province, Saudi Arabia. The dependent variable is the use of an electronic triage system, and the independent variables are perceived ease of use, perceived usefulness of the system, training, social influence, behavioral intention, attitude, and demographic data.

Nurses play an essential role in this research because they are responsible for using the triage system. Our sample size includes nurses who use an electronic triage system in the Emergency Departments of King Fahad University Hospital (KFUH) in Dammam and of Dammam Medical Complex. Nurses in other departments, physicians, and other allied health professionals were excluded.

An online survey was created using the technology acceptance model (TAM) to collect the necessary data for the study. The TAM is the most suitable model for this study because it helps investigate the main reasons behind the nurses' compliance with the utilization of the E-CTAS system. The first part included questions about personal information, including the participant's age, gender, experience, certificate (ie, last educational degree), and nationality. The second part asked

whether the participant had experience working in triage. The third part contained questions to determine the frequency of E-CTAS use as well as the courses taken. The last section contained 24 questions about the E-CTAS to measure the acceptance and thoughts about the system. The questions were written as statements with multiple-choice scale answers to show the agreement range for the system.

The TAM was selected to discover and measure the main influences that affect nurses' usage of the system. The TAM has three major domains, these are: perceived ease of use, perceived usefulness, social influence, behavior intention, and attitude towards using the system. These domains were scored as continuous values, with higher scores indicating better perceived ease of use, better perceived usefulness, better social influence, better behavior intention, and a better attitude.

Participants had to indicate their E-CTAS usage through using one of the following options: do not use at all, use less than once each week, use about once each week, use several times a week, use about once each day, or use several times each day. The usage was then categorized into two groups, anyone who selected the option that they have never used the system were considered non-users, while the rest of the groups are considered users.

The online survey was distributed among nurses working in the Emergency Departments of KFUH and Dammam Medical Complex. This study started in September 2018 and concluded in April 2019. In addition, the research was ethically approved by the Institutional Review Board of Imam Abdulrahman Bin Faisal University (approval no. IRB-UGS-2018-03-263). Participant completion of the survey is deemed to be informed consent, as this was mentioned in the cover letter of the survey. Participating in the study is mandatory.

Microsoft Excel was used to insert the data, which were then converted to SPSS to ensure no data were missing or incorrect before the data analysis. Summaries and percentages are used to summaries categorical variables and measures of central tendency are used for continuous variables in the study. Normality was checked through the Skewness and Kurtosis criteria in SPSS.⁸ Since the outcome variable in the study is the usage of E-CTAS (user/non-user), *t*-tests and chi-square tests were used for bivariate analysis. A *p*-value of less than 0.05 was considered significant.

Results

Forty-two nurses from the study sample indicated that they use the E-CTAS, while 29 have never used the tool

Table 1 Bivariate Analysis of Factors Influencing E-CTAS Use

Variables	Nonusers n= 29 (%)	Users n= 42 (%)	χ^2 Test
Gender			
Male	6 (21)	16 (38)	2.430
Female	23 (79)	26 (62)	$P=0.119$
Nationality			
Saudi	11 (38)	8 (19)	3.121
Non-Saudi	18 (62)	34 (81)	$P=0.077$
Years of Experience			
< 1 year	11 (38)	3 (7)	13.385
1–5 years	6 (21)	16 (38)	$P=0.004$
5–10 years	12 (41)	18 (43)	
> 10 years	0 (0)	5 (12)	
Number of Training Courses Taken			
No course	3 (10)	20 (48)	12.929
1 course	5 (17)	5 (12)	$P=0.005$
2 courses	1 (3)	5 (12)	
> 2 courses	0 (0)	12 (29)	
Age Group			
Younger than 30	14 (48)	12 (29)	3.620
30–39 years	11 (38)	21 (50)	$P=0.460$
40–49 years	3 (10)	7 (17)	
50–59 years	1 (3)	1 (2)	
60+	0 (0)	1 (2)	

(Table 1). Most of the participants were females (69%). Only 23% of the participants were Saudis. The participants' years of experience ranges from less than 1 year (20%) to more than 10 years (7%), while most participants had between 5 and 10 years of experience (42%). More than 30% of the participants have never had any training courses in ETSS. Most of the participants were from the age group 30 to 39 years old, followed by nurses younger than 30 years old (37%).

To communicate clear relationships between the variables of concern in this study, the variables were analyzed using *t*-tests and chi-square tests. The overall purpose of the bivariate method is to determine the empirical relationships between the study variables.

Bivariate analysis shows the relationships between E-CTAS usage and the TAM domains: perceived ease of use ($t = -3.638$, $P=0.001$), perceived usefulness ($t = -2.509$, $P=0.016$), training ($t = -3.418$, $P=0.001$), social influence ($t = -3.039$, $P=0.003$), behavioral intention ($t = -2.847$, $P=0.006$), and attitude ($t = -2.955$, $P=0.005$) (Table 2). In general, users perception about the E-CTAS is better compared to non-users, that is in regards to the abovementioned aspects.

The years of nurse's experience influenced their usage of the E-CTAS significantly ($\chi^2 = 13.385$, $P=0.004$). Among nurses who had less than 1 year of experience at the hospital, 11 (79%) were non-users of the E-CTAS. On the other hand, most of the participants who had between 1 and 5 years of experience (22 nurses) were E-CTAS users (73%). In addition, among participants with 5–10 years of experience, there were more E-CTAS users (60%) than nonusers (40%). As years of experience increase, participants are more likely to become E-CTAS users (see Table 1 and Figure 1).

The number of training courses the nurses received influenced significantly on their usage of E-CTAS ($\chi^2 = 12.929$, $P=0.005$). Many participants who did not use the system also did not receive training (53.49% of the participants did not take courses). Among those who received one training course, the number of system users (50%) was equal to the number of nonusers (50%). In addition, 83% of participants who received two courses used the system. Moreover, all of the triage nurses who took more than two courses used the E-CTAS (see Table 1).

Furthermore, gender, nationality, and age group were not significantly different among users and non-users of the E-CTAS.

Table 2 Bivariate Analysis of Differences Between Users and Nonusers of the Electronic Triage System

Variable	Nonusers (n = 29)	Users (n = 42)	Mean Difference	Test Statistic (t)	P-value
	Mean (SD)	Mean (SD)			
Perceived ease of use	14.34 (5.29)	18.43 (3.53)	-4.084	-3.638***	0.001
Perceived usefulness	18.17 (8.50)	22.79 (6.12)	-4.613	-2.509*	0.016
Training	6.48 (2.59)	8.43 (2.19)	-1.946	-3.418**	0.001
Social influence	6.79 (2.51)	8.64 (2.53)	-1.850	-3.039**	0.003
Behavior intention	4.24 (2.31)	5.62 (1.77)	-1.378	-2.847**	0.006
Attitude	5.07 (1.94)	6.31 (1.39)	-1.241	-2.955**	0.005

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

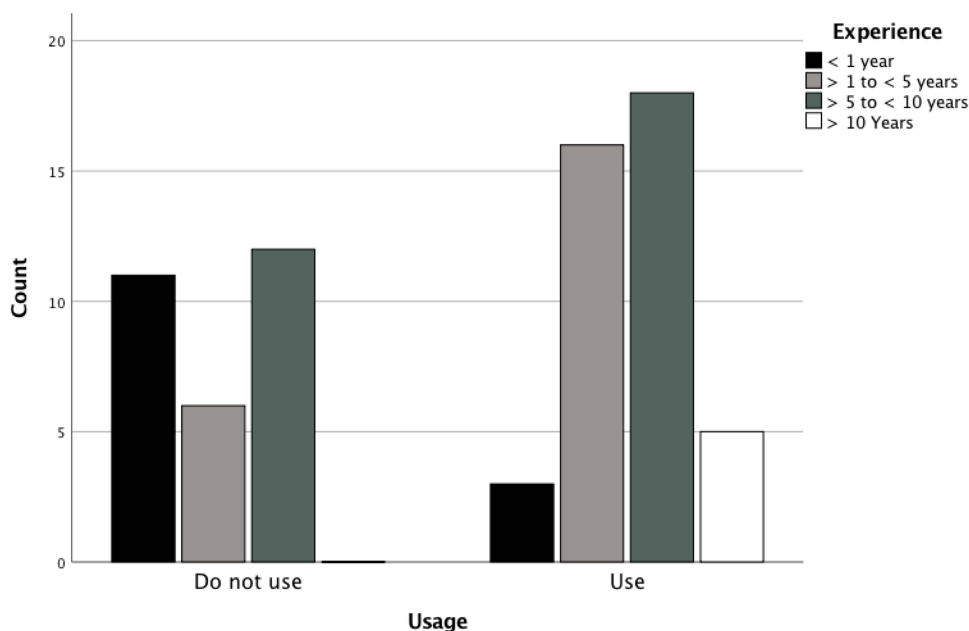


Figure 1 Bar chart showing the positive effect of years of experience on E-CTAS usage.

Discussion

The research study assessed how nurses working in the Emergency Departments of KFUH and Dammam Medical Complex Hospital adopted an ETS. We utilized bivariate analysis to determine the differences between nurses who used and did not use the ETS. As shown by the findings, we observed significant differences between nurses who used the triage system and those who did not use it, in terms of ease of use, usefulness, training, social influence, behavioral intentions, and attitude. Furthermore, the current results confirmed previous studies showing that ETS use increases if the nurses believe that the ETS is understandable and easy to use and will help to improve performance.⁹ Moreover, nurses' attitudes concerning the ETS played a role in how they perceived and desired to use the ETS. All the same, Saudi nurses had lower preference for using the ETS compared to non-Saudi nurses.

According to Dong, Bullard, Meurer, Blitz, Holroyd, Rowe¹⁰ the triage process helps to ensure effective management of a modernized emergency department, to ensure patients receive clinical justice. As shown by the study's findings, nurses are using ETSs to help patients with urgent issues or trauma. However, the nurses did not have a clear understanding of when to use the ETS during emergency cases. At the same time, 65% of the nurses in the current study conveyed that the triage system was effective in identifying patients who needed to be

immediately referred for emergency services and that this helped with reducing cases of patient overcrowding.

Lyons, Brown, Wears¹¹ argued that various factors influence the effectiveness of triage performance, including human factors such as long working hours and crowding. In their study, coordinated nursing care helped to solve the conflicts that affected the nurses in making decisions. According to Choi, Wong, Lau¹² triage nurses' decisions are usually affected by their responsibilities and how patients constantly flow into the emergency department. In some cases, this was presented as a challenge that decreases the effectiveness of how nurses performed their duties.¹²

Aljohani¹³ showed that most nurses continue to use the ETS because they see its benefits. Because the technology shows positive outcomes, nurses desire to continue implementing it in their environment to ensure they could correctly carryout patient care services.¹⁴ In addition, the nurses wanted to use the triage system because they wished to deliver appropriate clinical care and ensure satisfactory health care to patients.¹⁴

The reliability and validity of ETSs have been supported by resources such as nurses specializing in triage downloading an ETS application on an iPad to help manage the volume of patients admitted into the emergency department.¹⁰ Thus, triage has an objective of assigning urgency to patients for system efficiency and clinical justice.¹⁰ On the other hand, patients' perceptions concerning the triage approach influence

nurses' choice to use the system. Nevertheless, when patients use the triage system, they support further initiation of treatment and assessment in the care process.

However, the current study has various limitations. First, it was not possible to reach a large sample of nurses who deal with E-CTAS triage because the E-CTAS is not fully applied in Saudi Arabia yet. Thus, the information may have been biased because the limited number of nurses may not accurately reflect the reality of E-CTAS usage, and it is difficult to generalize the results. In addition, very few studies have tried to analyze nurses' ETS use; thus, it was not possible to compare and contrast information from other researchers due to the limited resources.

The current study reveals that different factors contributed to nurses in Saudi Arabia using the triage system. The factors included the nurses' perceptions, as well as how easy they thought it was to use the system. As a result, nurses who did not use the triage system were limited by these factors, whereas those who used the system were motivated by these factors. In our study, personal factors such as years of experience played a major role in the nurses' choice whether to use the triage system.

Conclusion

In conclusion, a hospital's emergency department serves patients who are in critical condition. Hence, this department is likely to receive many patients, so effective strategies to support immediate care help to facilitate patient wellbeing. The triage system positively affects the emergency department. Through the system, patient needs are prioritized depending on their medical condition's severity. Thus, the emergency department triage system has proven to be a viable, effective instrument that also enhances equality in patient care.

E-CTAS usage is viable in improving the quality of healthcare service provided to patients with urgent needs. The study revealed that several aspects influence the nurses' usage of the E-CTAS. These factors include all the TAM domains, ie, perceived ease of use, perceived usefulness, social influence, behavioral intention, and attitude. Further, the number of training courses and years of experience influence the usage of E-CTAS positively.

Therefore, E-CTAS usage must be improved through continuous attempts at improvement and training. It is

recommended that nurses be trained and mentored on the need for ETS, which will lead to a significant increase in its usage. In addition, further studies with larger sample sizes are needed in this area to enhance E-CTAS usage in Saudi Arabia.

Disclosure

The authors report no conflicts of interest in this work.

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