

# Comparing Accuracy of Manual Triage with Electronic Triage System

Wael N. Eid<sup>1,\*</sup>, Hussein M Borie<sup>2</sup>

<sup>1</sup>Emergency Department, King Abdullah Medical City, Makkah, Saudi Arabia

<sup>2</sup>Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Saudi Arabia

\*Corresponding author: [Wael19@hotmail.com](mailto:Wael19@hotmail.com)

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**Abstract BACKGROUND:** Triage is the process of sorting patients in the emergency department (ED) based on the severity of their clinical presentation. There are several protocols to categorize patients and provide order in which and where a patient will be seen in the ED. It is a useful tool for organization and managing resources in the ED. **OBJECTIVE:** This research aims to compare the accuracy and applicability of the electronic Canadian Triage and Acuity Scale (CTAS) to the manual CTAS system. **DESIGN:** It is a descriptive, analytical prospective study that was conducted in King Abdullah Medical City (KAMC), Makkah, Saudi Arabia. **SUBJECTS AND METHODS:** During the study period, 389 patients were triaged with both manual and electronic CTAS triaging systems. **RESULTS:** Our research shows a low strength of agreement between manual and electronic triaging systems. The scores differ significantly that we cannot interpret the accuracy between the two systems. Additionally, our study shows that the predominant triaging score was CTAS 3 in both electronic and manual triaging systems and this could reflect the higher acuity of patient presentations to KAMC ED. KAMC is a specialized tertiary care center where patients frequently require a higher level of care. **CONCLUSION:** Our research demonstrates the potentials of improving the triage process in the ED. Furthermore, this research highlighted the higher acuity of patients presented to KAMC ED and we believe this can give insight and further guidance for staffing, type, and the number of beds needed for our ED. However, further studies are needed to compare the electronic versus the manual triaging systems regarding the time required for completing the triage, impact of bed occupancy at the time of triage, as well as the number of staff available.

**Keywords:** manual triage, electronic triage system

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## 1. Introduction

Triage is a protocol in the emergency department through which patients were sorted according to the severity and the clinical presentation using indicators such as the look of the patient, chief complaints, medical comorbidities, and vital signs [1]. It is done by a trained staff in the triage area to provide the best care for the patient based on his/her triage category. Sorting patients started in wars, so that care can give first to those who can quickly return to the battlefield [2]. Therefore, the less injured and less severe patients will be attended to first, and the sickest who need more time and resources will be attended to later. However, triaging in hospitals is the opposite, as the main goal is to allocate resources and care to the sickest patient first so, clinical care can be provided to the more severely ill patient first [3].

Triage has several goals and benefits for sorting patients in the waiting area of the emergency departments. It can help to determine and assess the patients' severity

and provide a sorting scale or order in which patients can attend by health care provider. Additionally, it helps in resource utilization and in which emergency department area patient's bed occupancy can manage properly. With triage, health care workers will be notified when a sick patient has arrived at the emergency department. Also, alert them if a patient poses a risk or health hazard such as infectious diseases, chemicals, or biohazards [3].

Henning E, et al carried out a study in 2020 titled "Digital versus analogue record systems for mass casualty incidents at sea—Results from an exploratory study" to evaluate the outcome, validity as well as reliability of an analogue and a digital recording triage system for triage of a mass casualty incidents at sea. They revealed that the number of patients triaged with the analogue system was significantly higher than with the digital system (79.75% versus 67.96%,  $p=0.001$ ). Correct triages were more observed with the digital system with lower significant ratio of under-triage,  $p=0.001$ . Validity was higher with the digital system. Sensitivity and specificity of the digital system were higher than the analogue system with no observed significant patterns of carry-over-effects. They

recommended further studies in utilizing of triage systems in training situations [4].

## 2. Significance of the Research

The accuracy of a triage system in an ED is of importance because it has implications on the utilization of hospital resources and the quality of care that is given to patients. In this regard, under triage and over triage are two outcomes that are common in the ED. ED triage staff sometimes categorizes the patients either above or below his/her actual triage level which is also called over/under triage and it may affect the medical care given to the patient, waiting time in ED and bed availability. The two outcomes are prevalent in EDs as captured in different studies. A study performed in a Swedish University Hospital with the aim of evaluating the compliance with trauma triage criteria, under-triage, over-triage, and the factors leading to miss-triage found that the prevalence of under-triage was at 2.7% while a higher prevalence rate of over-triage was reported at 34.2% [5].

The problems that sometimes we face either in ED triage that the triage staff categorizes the patients above or below his/her actual triage level which is also called over/under triage. An electronic triage system is a software application that categorizes the patient based on the data entered by a triage staff and it will give us the level of category for the patient. This study was aimed to find the accuracy between the manual triaging and electronic triaging performed by triage nurse in KAMC that can utilize the health care leaders to create new work system for triaging and help to improve patient care in emergency department.

### 2.1. Research Aims and Objectives

The goal of the research was to find out the accuracy between the manual triaging and electronic triaging performed by triage nurse. This aim is achieved through the following objectives:

1. To compare the accuracy of emergency department triaging score between manual triaging and electronic triaging system.
2. To identify the common chief complaints of the patients.
3. To determine the proper distribution of patients in emergency department based on triaging score.

### 2.2. Research Hypothesis

1. There is a significant relationship exist in the accuracy between Manual Triaging score and Electronic triaging score.
2. There is a significant difference exist between Manual Triaging and Electronic triaging accuracy.

### 2.3. Research Methodology

The design of this study is a descriptive-analytical prospective study design. A simple random sample of 389 patient was included in this study with both electronic and manual to compensate for possible incomplete or inaccurate responses.

### 2.4. Sample Size

Emergency Department census: estimated that we have between 2500 and 3000 ED visit per month. Assuming that the probability of agreement between two random observers on a random case as 0.539, based on a previous study Beveridge et al [6], using the Roasoft sample size calculator at 95% confidence interval and 5% margins of error, a minimum sample size of 339 was estimated.

### 2.5. Data Collection Tools

The electronic CTAS system, developed by Pacific Rim Nursing Consultants Inc. (English version) was utilized in this study, in addition to the manual CTAS used currently by the hospital. The electronic CTAS system is an official application of the Canadian Triage and Acuity Scale (CTAS). It walks the user through patient complaints in assisting nurses and physicians to assign acuity levels using the complaint-oriented triage lists and modifiers.

### 2.6. Data Collection Methods

Patients were triaged initially as the standard triage by ED triage staff. The staff entered the data according to patient vital signs and complaints. At the same time, another staff using an electronic CTAS triage software application triaged them. The staff using the electronic triage entered all the data required for the study use only without interfering with the standard medical care. The data were saved in a laptop or tablet that is password-protected that is available only at the emergency department in a secured safe place that has no access except for principal investigator and co-investigators. At the end of the shift, the researcher plotted all data in a document that has MRN, manual and electronic triage level.

## 3. Validity and Reliability

Mustafa, et, all 2015 conducted a study to test the reliability of Canadian Emergency Department Triage and Acuity Scale (CTAS) in Saudi Arabia. They utilized CTAS guidelines to independently assign a triage level for 160 real case-based scenarios. Quadratic weighted kappa statistics were used to measure raters' agreements. The study concluded that CTAS has good reliability among emergency department (ED) triage nurses in King Abdul-Aziz Medical City (KAMC), Saudi Arabia. The findings suggest that CTAS might be a reliable instrument when applied in countries outside Canada [7].

We tested the software with 10-20 patients to determine the accuracy of the Application Asking expert ED consultants and Expert Triage Nurses. The expert validity also concluded that the electronic triaging software could be applicable in the ED to triage patients.

### 3.1. Ethical Considerations

The researchers were committed to all ethical considerations required to conduct the research. Before data collection, the researchers obtained official

permission from IRB at King Abdullah medical city Research Center. Confidentiality was respected throughout the research steps.

All subject nominative data are removed; all data files are secured and only used by researcher and after concluding the research all data will be deleted.

### 3.2. Statistical Techniques

The categorical variables were presented as frequency and percentage. Agreement between the manual and electronic systems` findings were tested by the Kappa test. All statistical analyses were performed by using Statistical Package for Social Sciences (SPSS), version 25 and P-values <0.05 were considered statistically significant.

## 4. Results

Figure 1 show that a total of 389 patients were triaged with both Manual and Electronic triaging system during study periods. The enrolled patient’s chief complaints were recorded as follows. Most of the patients have complaints of abdominal pain and Shortness of breath

(24.9%). Patients with chest complaints also noticed higher number (18.3%). Remaining was Headache (11.8%), Vomiting (10.5%), Fever (8.5%), Diarrhea (0.5%), cough (0.3%) and palpitation (0.3%) respectively.

Table 1 shows that the result of descriptive analysis of CTAS score by using Manual scoring system. The result shows that most of the patients triaged by manually is coming CTAS score three that is 81.3%. Remaining was 12.3% CTAS score four, 5.9% CTAS score two, and 0.5 % CTAS score five.

Table 2 shows that the result of descriptive analysis of CTAS score by using Electronic scoring system. The result shows that most of the patients triaged by electronically is coming CTAS score three that is 57.1%. Remaining was 20.1% CTAS score four, 19% CTAS score two, and 3.9 % CTAS score five and no patients given CTAS score one.

Table 3 shows that the result of analysis of cross relation between the Manual and Electronic triaging score by using CTAS scoring system. The above table indicate most of the patients were coming in CTAS score three in both Manual (315) and Electronic (222) and remaining score was as follows CTAS score four Manual (48) electronic (78), CTAS score two Manual (23) electronic (74) and CTAS score five Manual (2) electronic (15).

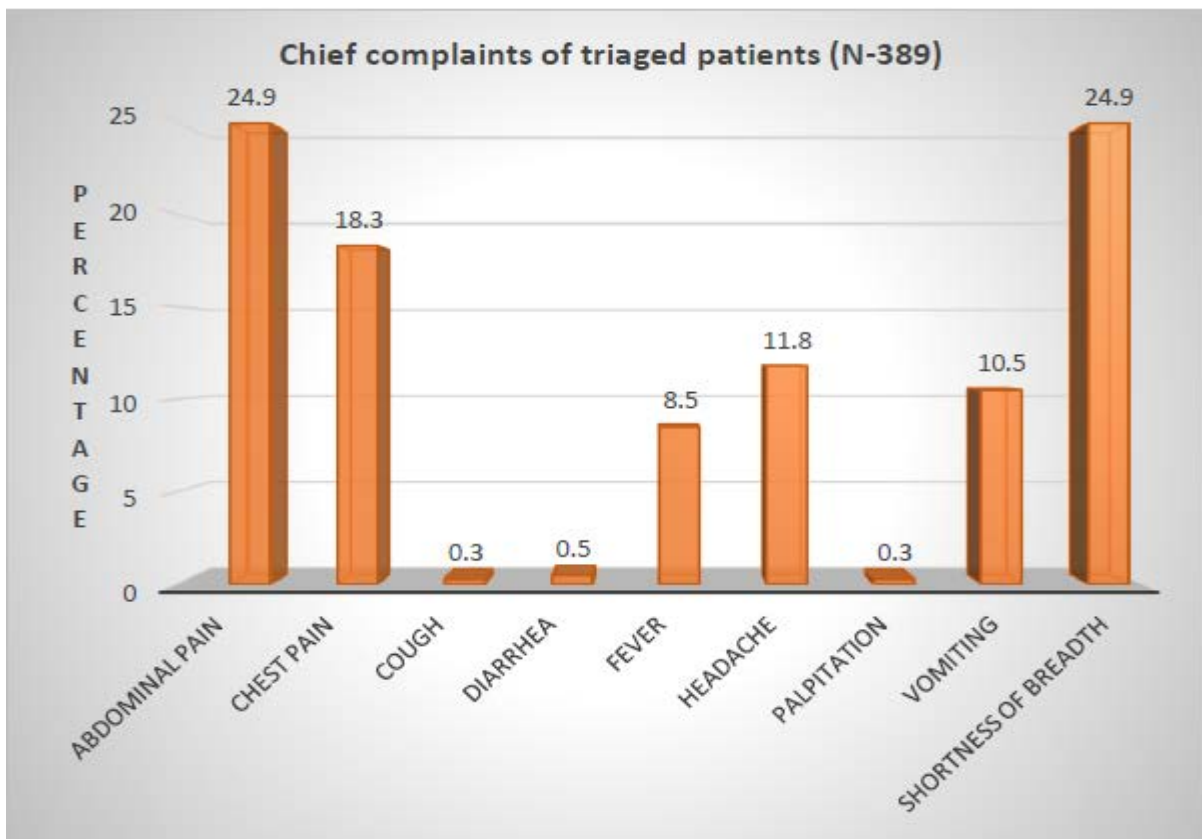


Figure 1. Chief complaints of the triaged patients

Table 1. Descriptive analysis of CTAS score by using Manual scoring system

| Manual Score | Frequency | Percentage |
|--------------|-----------|------------|
| 2.00         | 23        | 5.9 %      |
| 3.00         | 316       | 81.3 %     |
| 4.00         | 48        | 12.3 %     |
| 5.00         | 2         | 0.5 %      |
| Total        | 389       | 100 %      |

Table 2. Descriptive analysis of CTAS score by using Electronic scoring system

| Electronic Score | Frequency | Percentage |
|------------------|-----------|------------|
| 2.00             | 74        | 19 %       |
| 3.00             | 222       | 57.1 %     |
| 4.00             | 78        | 20.1 %     |
| 5.00             | 15        | 3.95 %     |
| Total            | 389       | 100 %      |

**Table 3. Analysis of cross relation between Manual and Electronic triaging scoring system**

| MANUAL and ELECTRONICS Triaging score Cross Tabulation |   |             |      |      |      |       |
|--|---|-------------|------|------|------|-------|
| CTAS SCORE   |   | ELECTRONICS |      |      |      | Total |
|  |   | 2.00        | 3.00 | 4.00 | 5.00 |       |
| MANUAL   | 2 | 12          | 8    | 2    | 1    | 23    |
|  | 3 | 62          | 198  | 46   | 9    | 315   |
|  | 4 | 0           | 14   | 30   | 4    | 48    |
|  | 5 | 0           | 1    | 0    | 1    | 2     |
| Total  |   | 74          | 222  | 78   | 15   | 389   |

Table 4 shows the comparison of accuracy between Manual and electronic triaging scoring by using Cohen's Kappa (K) test. The kappa value (k) shows 0.245, which represents low strength of agreement between both manual and Electronic triaging system. This result indicates not interpret the accuracy between manual and electronic triaging. Furthermore, p values show that 0.000 (which means  $p < 0.005$ ) that is kappa (k) coefficient shows statistically significant different from zero. It shows that Manual and electronic triaging scoring methods are significantly difference in their relationship.

**Table 4. Analysis of comparison of accuracy between Manual and Electronic triaging scoring system**

| Symmetric Measures   |       |       |  |                            |                          |
|--|-------|-------|--|----------------------------|--------------------------|
|  |       | Value | Asymptotic Standard Error <sup>a</sup> | Approximate T <sup>b</sup> | Approximate Significance |
| Measure of Agreement   | Kappa | 0.245 | 0.040                                  | 7.724                      | 0.000                    |
| N of Valid Cases   |       | 389   |  |                            |                          |
| a. Not assuming the null hypothesis.                                 |       |       |  |                            |                          |
| b. Using the asymptotic standard error assuming the null hypothesis. |       |       |  |                            |                          |

Table 5 shows the Spearman's rank-order correlation to determine the relationship between Manual triaging score and Electronic triaging score. The result shows a positive correlation between two study variables, which was statistically significant ( $R = 0.385$ ,  $p < 0.001$ ).

**Table 5. Relationship between Manual and Electronic triaging score**

| VARIABLES  | SPEARMAN RANK CORRELATION | P VALUE     |
|------------|---------------------------|-------------|
| MANUAL     | 0.385                     | $P < 0.001$ |
| ELECTRONIC |                           |             |

## 5. Discussion

This research project was aimed to assess the accuracy between the manual triaging and electronic triaging performed by triage nurse at KAMC. This study was applied to identify common chief complaints of patients coming to emergency department, and the study objectives included were to determine the proper patient distribution based on triaging score. As far as we know, there has been no previous similar study that was conducted in this area. This result can help guiding healthcare leaders to design and optimize bed occupancy in their emergency departments. The results show that there is low strength of agreement between manual and electronic system, and that manual and electronic triaging score demonstrate a statistical difference in the relationship.

The results show that most of the patients presented to our ED were in the CTAS category 3, where they all in need of acute care and need to be attended by an emergency provider within 30 minutes. This result is in line with Arafat A who reported that the majority of their patients were at CTAS score 3 [8]. A study done by Jimenez J showed that most of their triaged patients scored 4 in Andorra [9]. Another study showed the majority of the patients included where in CTAS category 4 and 5 [10].

In addition, since our results showed that most of our triaged patients were in the CTAS category 3 which means the time to see an ED provider should be less than 30 minutes. This raises some concerns for any hospital with similar sitting includes, waiting time of the patients, and availability of bed space. This observation is strongly supporting by another study with similar observations and concerns [10]. Another study done by Devkaran mentioned that prevalence of CTAS category 3 in their triage was linked to a prolonged length of stay in their emergency department [11]. When trying to explain the prevalence of CTAS category three in our study, we think the reason may be our hospital is specialized tertiary care center where most patients are transferred from other hospitals for specialized care. Those findings might help guide hospital leaders with similar sitting to consider revising bed types and capacity to optimize care delivery in a safe and efficient way.

When proving the hypothesis, the results show that the accuracy between Manual and electronic triaging scoring cannot be indorsed. Kappa value (k) of 0.242 represents low strength of agreement between both manual and Electronic triaging system. This is an important finding where a similar observation was noted by Bolduc et al, where there was no significant difference in the accuracy level of electronic triage when compared to the manual triage irrespective of the acuity with which the patients presented and the type of provider [12]. It was also found that Manual and electronic triaging scoring methods are significantly difference in their relationship. This result is line with Dugas et al. who mentioned that electronic triage is fundamentally distinct, and its use differ from manual triaging and this support this study findings [13].

The hypothesis also proving that there is relationship exist between manual triaging score and electronic triaging score. A study done by Dong et al was pointing out that nurses show comfort when using electronic triage [14].

Pearson Correlation of both Manual and electronic triaging shows that 0.385 that indicate the existence of relation between both and the scattered diagram also showing upward trends. This result indication the relationship between both electronic and manual triaging. This study results concluded that a further study is needed to validate and optimize electronic triaging system and then test its applicability in comparison to the current manual triage.

## 6. Conclusion

This study reflects the relationship between both Manual and Electronic triaging system in the emergency department. The result shows that most patients coming in CTAS score three in both Manual and Electronic.

The results show that there is low strength of agreement between manual and electronic system, and that manual and electronic triaging score demonstrate a statistical difference in the relationship.

The study findings suggest that hospital leaders should focus patient bed distribution based on the triaging score. However, further studies are required to include triaging time for both manual and electronic triaging and waiting time of the patient in emergency room that will help to implement new methods of triaging process in the hospital.

## 7. Limitations of the Study

A limitation of this study was to be included time taking for completion of both manual and electronic triaging process. So, the result can use to implement new changes in the emergency department. The study relies on patient category and CTAS scoring only if including total time taking for both manual and electronic triaging can help the department for implementing changes in triaging process.

## 8. Recommendations

This study finding will help the hospital leaders to make changes towards emergency room triaging process. The result of the study showing the relationship between manual and electronic triaging system that will help the health care leaders to prepare new changes in emergency department triaging process. This study recommending for future study including triaging time required for both manual and electronic triaging and its accuracy in the scoring in hospital settings.

## 9. Direction for Further Research

This study strongly recommending to for further research by comparing total time taken for both manual and electronic triaging process in hospital. And also, as multicenter comparative study to find the effectiveness of manual and electronic triaging process. That findings can contribute to implement the multilevel health care settings to implement changes regarding emergency department patient triaging process.

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