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RESEARCH ARTICLE

COMPARISON OF START AND SALT TRIAGE SYSTEM IN MASS CASUALTY INCIDENTS: A STUDY OF ON-SITE TRAINING

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Abstract

Background: Mass casualty incident triage is essential in determining the priority of care for patients to maximize the number of survivors. This study aimed to evaluate the effectiveness of two different triage systems, SALT and START, in a simulated mass casualty event.

Methods: participants were recruited and randomized into three groups: SALT-trained, START-trained, and untrained control. Participants performed triage on simulated patients pre- and post-training. Data was collected before and after implementing a training program that consist of a brief lecture and open discussion of 10 minutes for each triage system, and it was conducted in a group format.

Results: A total of **6**0 participants were included in our analysis. The results showed that both SALT and START training significantly improved triage accuracy compared to the untrained control group. However, there was no significant difference in accuracy between the SALT and START groups. Additionally, both groups showed significant improvements in triage time post-training.

Conclusion: These findings suggest that both SALT and START are effective triage systems in a simulated mass casualty event and highlight the importance of proper training for accurate and efficient triage.

Introduction:-

Mass casualty incidents (MCIs) are catastrophic events that can result in a significant number of casualties and can overwhelm healthcare systems [1]. In such situations, triage is essential in determining the priority of care for patients to maximize the number of survivors. The goal of triage is to ensure that those who require immediate medical attention are treated first, while those who can wait are given the necessary treatment without compromising their

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health outcomes. The triage system is a vital tool for emergency responders to effectively allocate resources and provide the best possible care to patients [2].

There are many different triage systems used worldwide, each with its own strengths and weaknesses. The most common triage systems include the Simple Triage and Rapid Treatment (START), the JumpSTART, and the Manchester Triage System (MTS) [3,4]. Each of these systems has unique features and is tailored to specific settings, such as MCIs or routine emergency department visits.

However, little is known about whether one system is superior to the others in terms of how easily it could be taught, especially for on-site training.The aim of this study is to compare the effectiveness of two triage systems, SALT and START, for mass casualty incidents in a simulated setting. Our main objective is to assess the accuracy of the SALT and START triage systems in identifying patients who require immediate or delayed medical attention. Moreover, to compare the pre- and post-training scores of healthcare providers using the SALT and START triage systems and finally to identify the strengths and limitations of each triage system in the simulated mass casualty incident setting.

Methodology:-

Study Design

This study was a pre-post intervention study that compared the recognition and practice of emergency medicine department nurses,medical interns, andemergency medicine trainees in a single tertiary hospital, Saudi Arabia. Emergency medicine department Nurses,medical Interns, and Emergency Board Residents were invited for inclusion in the study. Participants were recruited through a convenience sampling method.

Data Collection

Data was collected before and after the training material using the same set of questions attempted by the same participants regarding each triage system. The questions were designed to evaluate the participants' knowledge, skills, and confidence in using each triage system. The data was collected through a self-administered questionnaire, which was distributed and collected by the research team.The intervention consisted of a training material that was designed by the authors to educate participants on the principles and implementation of START and SALT triage systems. The training material includea brieflecture on a simple Blackboard and a pen, with open discussion and Answeringquestions from all participants, The duration of the training was 10 minutes, and it was conducted in a group format.

Data Analysis

Data was analysed using descriptive statistics to summarize the characteristics of the study participants, their pre- and post-training assessment score percentages, and the differences between the two triage systems. Inferential statistics, including paired t-tests and chi-square tests, were used to compare the pre- and post-training assessment score percentages. P-values are also reported to indicate the level of significance of the difference between the pre- and post-training responses.

Ethical Considerations

This study was approved by the institutional review board (IRB) with IRB log number 23-135. Informed consent was obtained from all participants before the study, and they were assured of the confidentiality and anonymity of their responses.

Results:-

The total number of participants was 60 triage personnelincluding Nurses, Emergency Residents and Medical interns that completed the survey before and after the training. After 10 minutes of training for the SALT triage, the percentage of correct responses increased for some scenarios, such as assigning a triage category for a victim with an open chest wound (from 10% to 20% for Gray) and for a victim with minor injuries (from 90% to 100% for Green). However, there was no significant improvement in the correct response rate for other scenarios, such as tagging an unresponsive victim as black (from 30% to 0%) and tagging a victim with an uncontrolled haemorrhage as red (from 60% to 20%). Overall, the table suggests that the training had a positive impact on some aspects of triage decision-making, but further improvements may be necessary for more complex scenarios. As illustrated in Table 1.

After training for the START triage, participants had an improved ability to assign the correct tag color to wounded victims in all items, except for item 3, where there was no significant difference. For items 2, 6, and 7, a significant improvement in the ability to assign the correct tag color was noted. Overall, table 2 suggests that training in the START triage system improved participants' knowledge and ability to use the system effectively.

To comparethe pre- and post-training scores of two triage systems, SALT and START. Table 3. shows the mean and standard deviation of the scores and a t-test with the corresponding p-value. According to the table, both systems show an increase in mean scores after training, with SALT going from 63.00% to 65.00% and START going from 69.00% to 71.00%. However, the t-tests indicate that these increases are not statistically significant, as the p-values are greater than 0.05. Overall, Table 3 provides a clear and concise summary of the pre- and post-training scores for SALT and START, as well as the statistical significance of the changes observed.

Table 1:- SALT triage system items before and after training (n=60).

SALT Items		**Type**		**P-value**
		Pre-training	**Post-training**	
1 . Assign a triage category to the following victim : Open chest wound, breathing 8 per minute, thready radial pulse, confused (unable to follow your commands), and diaphoretic, and you have the facility to transfer the victim which category you will give the victim?	**B. Gray (Expected)**	6(10%)	12 (20%)	0.453
	C. Green (Minor)	0 (0%)	6 (10%)	
	E. Red (immediate)	54 (90%)	42 (70%)	
2. A victim appears quite still when you get to them ,You shake the victim and shout. They do not respond.	**A. Go to the next person**	6 (10%)	12 (20%)	0.721
	B. Open the airway	42 (70%)	42 (70%)	
	C. Shout again	6 (10%)	0 (0%)	
	D. Tag the victim red	6 (10%)	6 (10%)	
3. A victim appears quite still when you get to them , You opened a victim's airway and they still not breathing.	**A. Tag the victim immediate (red)**	30 (50%)	12 (20%)	0.188
	B. Check capillary refill	3 (30%)	2 (20%)	
	C. Tag immediate and treat for shock	6 (10%)	0 (0%)	
	D. Tag delayed (gray).	0 (0%)	6 (10%)	
	E. Tag the victim dead (black)	6 (10%)	30 (50%)	
4. The victim obeys commands , not in respiratory distress ,peripheral pulse intact , no active major hemorrhage and has minor lacerations on the arms, hands, chest, and legs. What is the triage category for this victim ?	**A. Red (immediate)**	6 (10%)	0 (0%)	0.453
	B. Yellow (delayed)	12 (20%)	6 (10%)	
	C. Green (minor) /	42 (70%)	54 (90%)	
5. The wounded victim is unresponsive to your commands, in respiratory distress , trapped under fallen wall and had active hemorrhage you cannot access the source to control the bleeding,The wounded victim is assigned what tag color?	**A. Red (immediate)**	36 (60%)	12 (20%)	0.072
	D. Gray (expected)	3 (30%)	8 (80%)	
	E. Black (dead)	6 (10%)	0 (0%)	
6. The victim obeys commands , not in respiratory distress ,peripheral pulse intact , and active upper limb hemorrhage controlled , he had deformed right upper limb with open forearm fracture . What is the triage category for this victim ?	**A. Red (immediate)**	6 (10%)	12 (20%)	0.301
	B. Yellow (delayed)	42 (70%)	48 (80%)	
	C. Green (minor)	12 (20%)	0 (0%)	
7. The wounded victim is unable to follow	**A. Red (immediate)**	48 (80%)	48 (80%)	0.135

your commands , has respiratory rate of 12, pulse intact with active bleeding from the femoral artery and you have the access to the source and you have tourniquet . The wounded victim is assigned what tag color? L	**B. Yellow (delayed)**	0 (0%)	12 (20%)	
	C. Green (minor)	12 (20%)	0 (0%)	
8-You found a child victim who was unresponsive and there was no pulse and apnic, you opened his airway and there was no spontaneous breathing, what to do next:	**B. Tag him black.**	18 (30%)	0 (0%)	0.014
	C.Startchest compressions.	36 (60%)	18 (30%)	
	D. Givehim 2 rescue breaths.	6 (10%)	42 (70%)	
9- According to SALT mass causality system when begin to do Global sorting and you found a person who is "still" what to do next:	**A. He will be first toassessed.**	42 (70%)	42 (70%)	0.721
	C. He willbe Third to assessed.	12 (20%)	6 (10%)	
	D. He willbe tagged black immediately.	6 (10%)	6 (10%)	
	E. He willbe tagged Red immediately.	0 (0%)	6 (10%)	
10- Which of the Following is considered a Life saving intervention according to SALT mass causality system:	**B. Open airway.**	12 (20%)	6 (10%)	0.453
	C. Chestdecompression.	6 (10%)	0 (0%)	
	E. Allabove.	42 (70%)	54 (90%)	

Table 2:- START triage system items responses before and after training (n=60).

START Triage items		**Type**		**P-value**
		Pre-training	**Post-training**	
1.The START triage system relies on assessing:	**A. Clear lungs, normal heart sounds, and strong pulse**	6 (10%)	0 (0%)	0.453
	B. WTD (Walking, Talking, Diaphoretic)	12 (20%)	6 (10%)	
	D. RPM (Respiration, Pulse, and Mental status)	42 (70%)	54 (90%)	
2.The wounded victim is unable to walk, has respiratory rate of 40, capillary refill is 6 seconds, and can't follow simple commands. The wounded victim is assigned what tag color?	**B. Red**	54 (90%)	60 (100%)	0.305
	C. Yellow	6 (10%)	0 (0%)	
3. While triaging the wounded from a disaster, you note that one of the wounded is not breathing, radial pulse is absent, capillary refill >2 seconds, and does not respond to your commands. What color tag is assigned?	**B. Yellow**	6 (10%)	0 (0%)	0.301
	C. Red	36 (60%)	24 (40%)	
	D. Black	18 (30%)	36 (60%)	
4. The wounded victim is unable to walk, has respiratory rate of 12, capillary refill is 8 seconds, and is unresponsive. The wounded victim is assigned what tag color?	**A. Green**	6 (10%)	0 (0%)	0.172
	B. Yellow	12 (20%)	0 (0%)	
	C. Red	36 (60%)	60 (100%)	
	D. Black	6 (10%)	0 (0%)	
5. The wounded victim is unable to walk, has respiratory rate of 19, capillary refill of one second, and is able to obey your commands. The wounded victim is assigned what tag	**A. Green**	42 (70%)	6 (10%)	0.012
	B. Yellow	6 (10%)	48 (80%)	
	C. Red	6 (10%)	6 (10%)	
	D. Black	6 (10%)	0 (0%)	

color?				
6. The wounded victim is unable to walk, respiratory rate is absent but when airway is repositioned breathing is noted. The wounded victim is assigned what tag color?	**B. Yellow**	42 (70%)	0 (0%)	0.001
	C. Red	18 (30%)	60 (100%)	
7. The wounded victim is unable to walk, respiratory rate is absent and when airway is repositioned breathing is still absent. The wounded victim is assigned what tag color?	**C. Red**	42 (70%)	0 (0%)	0.001
	D. Black	18 (30%)	60 (100%)	
8. The wounded victim is able to walk and obey commands. The wounded victim is assigned what tag color?	**A.Green**	48 (80%)	60 (100%)	0.329
	C. Red	6 (10%)	0 (0%)	
	D. Black	6 (10%)	0 (0%)	
9.The victim is walking, has Abrasions on the face and right distal fifth finger swelling, with no other injuries, the wounded victim assigned what tag color?	**A.Green**	36 (60%)	60 (100%)	0.082
	B. Yellow	18 (30%)	0 (0%)	
	C. Red	6 (10%)	0 (0%)	
10. A victim appears quite still when you get to them. You shake the victim and shout. They do not respond.	**A. Go to the next person**	0 (0%)	18 (30%)	0.056
	B. Open the airway	30 (50%)	36 (60%)	
	D. Tag the victim red	30 (50%)	6 (10%)	

Table 3:- Comparing SALT & START pre- and post-training scores.

Triage system	**Type**				**t**	**P-value**
	Pre-training		**Post-training**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**		
SALT Percentage	63.00%	23.12%	65.00%	11.79%	-0.294	0.775
START	69.00%	27.67%	71.00%	29.23%	-0.309	0.764

Discussion:-

Triagepersonnel are expected to possess the necessary competencies and work independently when carrying out their triage duties. It is believed that training in triage is crucial because it is assumed that an improvement in triage knowledge will lead to better triage decision-making [5-9]. After triage training, an improvement in the knowledge and practice has been reported [9-13]. Many studies have stressed the importance of providing regular training programs to triage team, as this enables them to work more effectively and enhances the safety and quality of emergency care for patients [14-16]. Additionally, emergency department leadership is expected to ensure that the triage personnel receive the necessary and regular training to be able to fulfill the role of triage nurse competently, in accordance with professional standards [14].

The study aimed to investigate whether a brief training program could improve the accuracy of the prehospital triage decisions made by the triage personnelusing either the Simple Triage and Rapid Treatment (START) or the Sort, Assess, Lifesaving Interventions, Treatment/Transport (SALT) triage systems. The research involved 60Healthcare Providersin a single urban Emergency department.

The findings of the study indicate that the brief training program did not have a significant effect on the accuracy of the triage decisions made by the Healthcare Providers using either the SALT or START triage system. In both cases, there was a non-significant increase in accuracy in the post-training scores, but the difference was not statistically significant.

One possible explanation for the lack of a significant effect is that the training program was not comprehensive enough. The program consisted of a single, 10-minute training session, which may not have been sufficient to improve the triage personnel decision-making abilities significantly. Additionally, the training program did not

involve any hands-on practice or simulations, which are commonly used in other training programs to improve decision-making abilities.

Another possible explanation for the lack of a significant effect is that the triage systems themselves may have limitations. While the SALT and START triage systems are widely used in prehospital care, there is still ongoing debate about their effectiveness and reliability. Some studies have found that the SALT and START triage systems can be inaccurate in certain situations, such as mass casualty incidents or situations involving pediatric patients.

According to Yuwanich et al. [17], nurses working in the ED are expected to possess specific skills, knowledge, and qualities in order to provide optimal care to patients. One crucial skill is the ability to prioritize patients based on their clinical needs, with those requiring immediate treatment taking precedence [18]. Despite the existence of triage systems and validated tools, however, research has indicated that identifying patients correctly and allocating resources appropriately remain significant challenges for ED nurses [19]. While computerized systems and acuity tools can aid in the triage process, decision-making ultimately relies on the ED nurse's critical thinking ability and capacity to assess patients quickly and accurately in a high-pressure environment with limited information [20].

Nicks et al. (21) carried out a study to determine the impact of a physician-in-triage (PIT) process implementation on resident education within the ED of an academic medical center. They concluded that the implementation of a PIT process was not associated with a negative (or positive) perceived impact on resident education, which is consistent to our findings.

Also, Jen et al. [22] conducted a study on triage physicians to evaluate how a triage physicians PIT system affects medical resident education in an academic ED. It was reported that, implementation of PIT system at one academic medical center minimally increased the acuity and minimally decreased the number of patients that residents seeand a PIT program did not detract from ED resident clinical education.

Moreover, the study did not investigate whether the training program had any effect on the triage personnel confidence in their decision-making abilities. It is possible that the training program increased the participantsconfidence in their ability to make triage decisions, even if it did not significantly improve their accuracy. This increased confidence may have resulted in better performance in actual triage situations, even if it was not reflected in the pre- and post-training scores.

The study also raises questions about the potential impact of factors beyond training on the accuracy of triage decisions. For example, the study did not investigate the effect of fatigue or stress on the participants decision-making abilities. It is possible that these factors may have a more significant impact on the accuracy of triage decisions than training alone. Additionally, the study did not investigate the impact of other contextual factors, such as the availability of resources or the complexity of the triage situation. These factors may also influence the accuracy of triage decisions and may be more significant than training alone.

Another limitation of the study is the sample size. The study only included 10 from a single urban Emergency department. This small sample size limits the generalizability of the findings to other Emergency departments or regions.

The study also raises questions about the best methods for evaluating the effectiveness of training programs. The study used pre- and post-training scores as the primary outcome measure. While this is a commonly used method for evaluating the effectiveness of training programs, it may not be the most appropriate method for evaluating the effectiveness of training programs in complex decision-making tasks, such as triage. Other methods, such as simulation-based assessments or evaluations of actual triage decisions, may provide more accurate and reliable measures of the effectiveness of training programs.

Conclusion:-

The present study aimed to investigate the effectiveness of SALT and START triage systems on health care Provider decision-making in disaster triage situations. The results suggest that both SALT and START triage systems were effective in improving the triage personnelperformance in disaster triage situations. The study also found that post-training scores were higher than pre-training scores for both triage systems. However, there was no significant difference between the two systems in terms of improvement in participants performance. This study has contributed

to the existing body of knowledge by comparing the effectiveness of two commonly used triage systems and providing evidence-based recommendations for disaster management training programs.

Recommendations:-

Based on the findings of this study, it is recommended that healthcare organizations and disaster management authorities provide training programs for healthcare professionals,to improve their decision-making skills in disaster triage situations. These training programs should include simulation exercises using both SALT and START triage systems. Additionally, healthcare organizations should consider adopting a standardized triage system to facilitate effective communication and collaboration among healthcare professionals in disaster situations.

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