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The Usage of Triage Systems in Mass Casualty Incident of Developed Countries

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Abstract

Victims are usually overwhelmed by local medical system in an unexpected mass casualty incident (MCI). Triage systems originate from wartime necessity to achieve the greatest efficiency to the maximum number of victims. In peacetime, the triage systems are applied to allocate constrained medical resources for the victims in MCI. There are several kinds of triage systems in different countries, such as Simple Triage and Rapid Treatment (START), Sort, Assess, Life-saving interventions, Treatment and/or Transport (SALT), Sacco Triage Method (STM), Careflight triage and Triage Sieve (TS). The START system is widely used in developed countries, especially in USA. The SALT is formulated by a work group of the Centers for Disease Control and Prevention (CDC) based on scientific data. STM is a triage algorithm designed for resource-constrained condition. Besides, the other triage systems show their power in managing the victims in MCI. However, the data of theses popular triage tools are mainly based on simulated tests, lacking of validity and reliability of triage systems. Therefore, the application, reliability, sensitivity and specificity of existing triage tools require to be validated in the real condition of MCI. Furthermore, due to the difference among triage tools used in different countries, international cooperation is demanded for a more highly organized mass-casualty medical response.

Keywords

Mass Casualty Incident, Triage Systems, Emergency Medical Resources Allocation

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1. Introduction

The term “triage” derived from French verb “trier”. In 1792, a military surgeon of Napoleon’s Imperial Guard, Baron Larrey, invented this technique to sort combat casualties into two categories: 1) patients who could physically return to battle; 2) patients who needed more complex medical treatment [1] [2]. With the development of organized medical systems in the world, triage rapidly developed in the emergency department in the UK, US, and Europe since early 1900s [2]. Today, triage is defined as the sorting of patients and allocating medical resources with priorities to maximize the number of survivors, especially in battle field and disaster [3]. The purposes of triage are to identify victims who have life-threatening injuries, assign patients to a predesigned care area, and to initiate therapeutic measures appropriately [4]. In peace time, mass casualty incident (MCI) requires rapid and efficient triage of victims. For example, in 2001, the World Trade Center was attacked and collapsed along with realization came the challenges of how to manage such incidents with limited medical resources and deal with long transportation times [4] [5].

The terms “disaster” and MCI, previously mentioned for rare instances, became hot point due to Terrorism such as The Oklahoma City bombing, London bombings, Sandy Hook Elementary School shooting [6]. Mass victims caused by Terrorism and other MCI demand an optimal triage to achieve the maximum number of survivors. However, most of triage methods are only for trauma triage applied in simulated scenarios, lacking sensitivity and specificity for MCI in real world. Besides, these systems are not ideal for prehospital treatment use where clinical parameters are measured [2] [7]. Therefore, the purposes of this review are to give a brief description of MCI, summarize different triage systems applied in MCI.

2. The New Characteristics of MCI

MCI refer to extreme situation that emergency medical services resources, such as personnel and equipment, are overwhelmed by the number and severity of casualties. Most of MCIs occur so suddenly and dramatically, resulting in a great number of victims [8]. The treatments in MCIs are different with overwhelming facility’s resources [9]. The injury patterns patients suffer from in MCIs are acute, diverse and complex. Patients with any combination of blunt, penetrating, and/or burn injuries could be encountered by paramedics [10]. They may also be the result of man-made events and natural disasters [11]. The intentional events are considered terrorism and the mortality caused by it alone doubled since 2007 [12]. What is more, sporting, religious events and some other planned mass gathering also provide the potential for terrorism attacks. In 2016, France was hit by terrorism in the city of Nice. More than 400 people were wounded and 86 people were claimed the lives over a distance of about 1.1 miles in the accident [13]. In 2017, a Richter 8.0 earthquake struck in Sichuan China, leading to more than 20 people died and over 400 people got injured in this disaster [14]. In the very recent days, over 500 victims suddenly appeared in the Las Vegas shooting. In face of plenty of trauma victims generated by MCIs, reasonable triage systems are urgely demanded to overwhelm the response capabilities with limited medical resources [1].

3. Triage Algorithms in MCI

The medical goal of triage in MCI is to identify the potential life-theatening injury, and to assign the patient an optimal treatment. Therefore, triage systems applied in MCI demand rapid identification of the critical injury in a complex mass casualty environment without detailed examination. There are several existing mass casualty triage systems used in many countries. Generally, these triage systems classify patients into 4 or 5 categories according to basic physiological criteria. The physiologic variables used in existing triage systems included walking, respiration, heart rate and consciousness [15]. However, the procedures of these triage systems are different from each other, leading to the various effects in the triage systems of MCI.

3.1. Simple Triage and Rapid Treatment (START) and Relative Triage Tools

Simple triage and rapid treatment (START) system, first introduced by Hoag Memorial Hospital and the Newport Beach, California, fire department, is the most commonly triage system used in USA [16]. The goal of START is "doing the greatest good for the greatest number". Based on parameters of walking, respiration, perfusion and mental status, the START system divides patients into 4 catagerories with different colors: immediate (red)—treatable life threaten injury; delayed (yellow)—treatable injury but not life threaten injury; minor (green)—not serious injury and expectant (black)—fatal injury or dead patient. The procedure of START, as shown in **Figure 1**, is consist of five major steps [15]. Initially, patients are asked to walk away for a short distance to a designated location. The ambulatory patients are labeled as "minor" with green color, and they will be reassessed after immediate treatment for patient with life threaten injury. Second, spontaneous respiration is examined. If the patient still do not have spotaneous breathing after airway is positioned, low priority is identified and he/she is labeled as "expectant" and considers as unsalvageable. Otherwise, spontaneous breathing is appreciated with or without position airway, the triage will continue to check the respiratory rate (RR). If RR > 30/min, the patient is regarded as immediate (red). If RR < 30/min, then perfusion is evaluated by radial pulse or capillary refill. If radial pulse absent or capillary refill > 2 second, the victim is considered immediate (red). If not, mental status is assessed in the last step. Victim who can not obey commands requires immediate treatment. Patient who can obey commands is regarded as "delayed" with yellow label.

Triage is an initial part of medical management in MCI. Since first introduced in 1980s, the START system is proved to be an effective triage system applied in

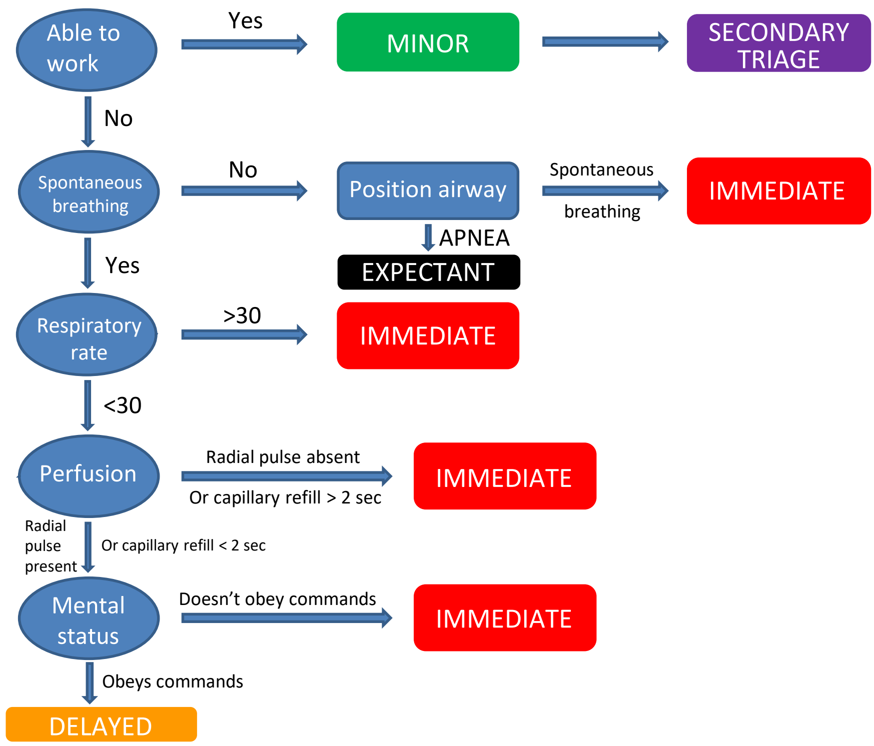

Figure 1. The procedure of Simple Triage and Rapid Treatment (START).

medical management in MCI. Gebhart *et al.* conducted a study to evaluated the efficacy of START triage to predict mortality in an MCI [17]. They randomly selected trauma patients and analyzed 355 victims by START triage. The result suggested that 75.77% of "delayed" patients were survival. What is more, they labeled victims with tabulated scores of 1, 2 and 3 and the mortalities of victims were 50%, 28% and 21% respectively. This comprehensive analysis implied that START triage can predict likelyhood of mortality effectively. Recently, Badiali *et al.* proved that the START system could improve the efficacy of triage in non-medical members even through a "last-minute" training [18]. Compared with non-START group, the accuracy of triage in START group was significantly increased, while the evaluation time was decreased. On the contrast, Kahn *et al.* found an opposite result in their study [19]. The performance of START system was assessed in a train crush. This study indicated that the outcome of START was poor in evaluating 148 victims. Among these victims, 79 were over-triaged and 3 were under-triaged by START. It was thought this may be because of failure of the triage tool itself. Use of START did ensure that almost all patients received at least as much care as was needed, but incorporated a significant amount of over-triage which may be wasteful of potentially limited resources.

As for pediatric victim, the jumpSTART system is designed for children aged 1 - 8 years old based on the START system [20]. The jumpSTART uses the same strategy of START with adding a five resue breaths in attempt to stimulate respiration in children who have peripheral pulse without breath. Wallis and Carley compared 4 pediatric triage tools including START and jumpSTART in 3461 children [21]. They found that both START and jumpSTART systems had a poor performance in identifying pediatric patients with serious injury, suggested that these two triage systems had low sensitivities in padiatric victims. To date, current literatures describing the practical application of jumpSTART in MCI are relatively rare, simulation study provides some important parameters of jumpSTART. Claudius conducted MCI Simulations to assess the accuracy and efficiency of jumpSTART in 2014 [22]. Thirty-three pre-clinical medical students were asked to assign 363 simulated pediatric patients. The average assigned time was 70.4 seconds, and the overall accuracy rate was 85.7%. Additionally, they found that omitted unnecessary action during triage can decrease time by mean of 5.5 seconds. Thus, this study suggested that jumpSTART is easy to learn by simulated scenarios.

Although the procedure of START system is clear to perform, learning and rehearsal are essential parts for rapid triage. Actually, education and simulated practice can significantly improve the accuracy rate and efficiency. Baez and colleagues [23] evaluated the effectiveness of a short educational intervention by two educational modules including disaster triage module and START module. They tested 55 emergency medical services (EMS) providers with 5 simulated scenarios. As a result, the accuracy rate was significantly improved in post-education test, compared to pre-education test (96.4% vs. 9.1%). Furthermore, a follow-up study at one month show that 34 of 38 respondents were correctly answered four or more scenarios. Thus, a short education can significantly impacted the EMS providers' ability to perform triage in a simulated casualty environment. Another study focused on the relative impact in virtual reality (VR) and standardized patient (SP) in simulated training by using START system [24]. Fifteen postgraduates were randomly assigned in VR group and SP group. The comparative study suggested that virtual reality provided a similar learning outcomes compared with traditional training methods. Besides, virtual reality expanded the types of disaster contexts.

However, like many other triages, the START system has limitations [25]. First, there is no differentiation between patients within categories, but the differentiation between categories can be prominent. Second, the START system do not consider deterioration in victim. If a victim's respiration, pulse and consciousness become worse after triage, START will undertriage these patients. Third, the START system devides victims based on vital signs, ignoring the type of traumas, which need secondary triage for further treatment in MCI. Fourth, the medical resources in a MCI are relatively limited, but the START system takes the same strategy whether the medical resources is shortage or not.

Because of some defects in START system, improvements had been tested in simulated study. In order to determine whether an additional Orange category (between the life threatening injured and the non-critical injured) could increase the accuracy rate of START, Arshad *et al.* compared the efficiency of two groups: the Fire Department of the City of New York (FDNY) applying modified START

(START with an additional orange category) and the Emergency Medical Services providers (EMS) using START [26]. The results show that modified START may decrease the rate of over-triage in MCI, comparing with traditional START system. In 2015, Lee and colleagues added a triage with the Canadian Triage and Acuity Scale (CTAS) after START in a MCI simulation exercise to improve the accuracy, but the outcomes show that this two-step triage did not increase the accuracy compared with START only [27]. Besides simulated studies, additional outcomes-based assessments are imperative for further improvement. These analyses must utilize data from actual disasters, as studies to date based on simulations may fail to predict the accurate results. Without such inquiry, it can not be possible to refine methodology meaningfully.

Widely used in north America, the START system show its power in both MCI triage and simulation study, even though it has some limitations. In conclusion, the START tool is an efficient triage system applying in MCI.

3.2. Sort, Assess, Life-Saving Interventions, Treatment and/or Transport (SALT)

In 2008, a work group of the Centers for Disease Control and Prevention (CDC) analyzed 9 existing mass casualty triage, but they found that none of this triage systems had enough scientific data to support their performance. Thus, they formulated the sort, assess, lifesaving interventions and treat/transport (SALT) systems [28]. According to the guideline, the procedure of the SALT system incuded two major steps (**Figure 2**) [29]. In step 1 (also termed as global sorting), patients are asked to walk to a collection area and purposeful movement. Based on the response of patients in step 1, the patients are classified as 3 categories: assess 1st (patients with the life-threatening injuries), assess 2nd (patients who can only move) and assess 3rd (patients who can walk independently). Consequently, individual assessment is performed in step 2. In step 2, lifesaving interventions (including major hemorrhage control, airway opening, chest decompression and auto injector antidotes) are provided to maintain patients' vital sign at first. After lifesaving interventions, if the patients without breathing, he/she will be regarded as dead. Otherwise, the patients are assessed by consciousness, peripheral pulse, respiratory distress and major hemorrhage control. The major difference in SALT system is the expectant category, which is represented using the color gray. The management of expectant category is majorly depending on the available medical resources and the number of victims.

Although the SALT system is formulated based on a comprehensive analysis of existing triage systems, the efficiency should be tested in MCI or simulations. Bhalla *et al.* compared the sensitivity and specificity of START and SALT system in a retrospective chart of 100 trauma patients. The results show that the accuracy of SALT was 65% with an overtriage rate of 5% and an undertriage rate of 30% [3]. This retrospective study implied that the accuracy rate was relatively low. Cone *et al.* evaluated the accuracy and triage time of SALT system by simulation [30]. Students were trained to use the SALT system. The accuracy of triage

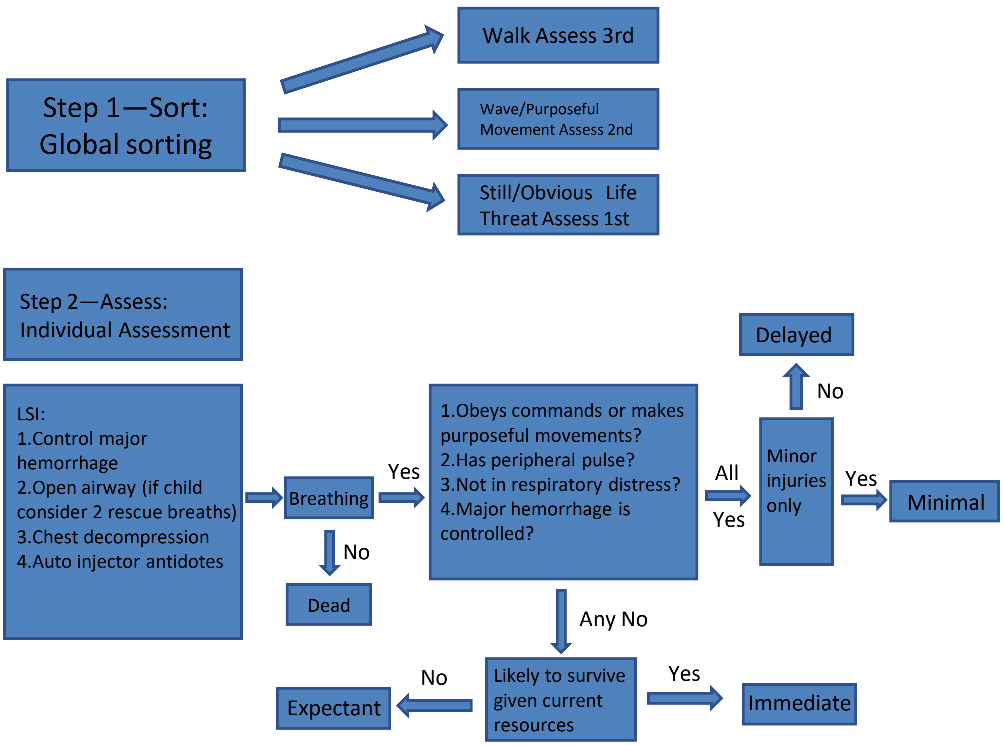

Figure 2. The procedure of Sort, Assess, Life-saving interventions, Treatment and/or Transport (SALT).

was 78.8% with an overtriage rate of 13.5% and an undertriage rate of 3.8%. In addition, the triage time ranged 5 - 57 seconds with a mean of 15 seconds. This simulation suggested that SALT system can be used adequately with short triage time. However, the effect of SALT should be investigated further. Similar study was also performed by Lerner and colleagues [31]. They tested the accuracy of SALT system through 73 trainees by simulated MCI. The overall triage accuracy rate was 83%, with 6% overtriaged and 10% undertriaged. The mean triage time was 28 seconds (ranged 4 to 94 seconds). In 2011, Cone *et al.* compared the SALT and Smart triage systems by virtual platform [32]. The overall accuracy rate of SALT by paramedic students was 70%, and the mean overtirage rate was 6.8%. This study suggested that trainees can improve their tirage accuracy using SALT system through virtual platform. Lee and colleagues conducted an investigation to evaluate the accuracy of SALT with different occupations (first-year primary care paramedic, fireman and policeman) in MCI. Among these people, primary care paramedics achieved the highest accuracy rate, and overtriage was the most frequent error [33]. Another study performed in firemen show that a brief training with the SALT triage algorithm can significantly improve the accuracy rate in firemen [34].

In pediatric population, the efficiency of the SALT system was proved to be as good as that of the jumpSTART system. Jones *et al.* compared two mass casualty triage systems including jumpSTART and SALT in a pediatric simulated mass casualty event [35]. Forty-three paramedics were divided into two groups: the

SALT group and the jumpSTART group. There were no significant difference between the SALT group and the jumpSTART group in triage accuracy rate, overtriage rate and undertriage rate. However, the triage time of SALT was 8 seconds longer than jumpSTART.

Based on comprehensive review on other triage algorithms, SALT was hypothesized to be a scientific triage algorithm. However, the parameters of SALT such as accuracy rate, overtriage rate, undertirage and tirage time are majorly derived from simulated studies so far, the efficiency of this triage tool should be investigated in the real environment of MCI.

3.3. Sacco Triage Method (STM)

Sacco triage method (STM) is a triage algorithm designed for resource-constrained condition [36]. Actually, STM is a mathematical model aiming at maximizing expected survivors with limited medical resources in the limited time and. It uses a linear programming formulation to evaluate which victims should be transported and treated first. RPM (consists of respiratory rate, pulse rate and best motor response) is used to assess severity of victims [37]. Sacco *et al.* estimated the survival probability by logistic regression based on the 76,459 blunt trauma patients from trauma centers in the Pennsylvnia Trauma Outcome Study. Besides, Delphi Technique is applied to evaluate victim deterioration. Sacco and colleagues compared the accurate predictor of survivability between STM and START triage tools. The results show that STM had more accuracy survivorship than START in simulations. In 2007, Sacco conducted another study on penetrating injury patients to assess the survivorship of STM [38]. The method of STM on estimating penetrating injury patients was the same as that on blunt trauma victims. In this simulation, STM were substantially more predicted survivors than START triage methods. According to the results of Sacco's studies, STM can predict survivorship based on RPM parameters. It is a resource-constrained triage method applied in MCI.

In order to test the performance of STM, Navin *et al.* evaluated STM triage method from 99,369 military-age victims. They found that RPM was an adequate predictive factor of survival probability. Compared with START triage system, STM increased survivalship significantly. Jain and colleagues compared the triage time and order between STM and START [39]. This analysis suggested that there was no significant difference of triage time between these two triage methods. However, the triage order was significantly different.

Some studies investigated the application of STM in pediatric population. Cross *et al.* evaluated the STM's performance in a pediatric population of 90,037 victims. After age adjustment, the area under curve (AUC) of predicted pediatric trauma mortality was 0.933 [95% confidence interval (CI): 0.925 - 0.940]. without the age adjustment, the AUC was 0.924 (95% CI: 0.916 - 0.933). The result implied that STM was a valid strategy to predict the mortality of pediatric patients in MCI.

Although STM is a mathematical model empirically designed for resource-constrained condition based on scientific data, its research data was majorly based on simulated studies. Thus, the efficiency of STM triage model should be tested in real-world of MCI.

3.4. Careflight Triage

Careflight triage tool is widely used in Australia as first response of emergency medical services (EMS) for MCI rescue [40]. The procedure of Careflight is consisted of 3 steps. In the first step, Careflight classifies patients by walk. If the patients can walk, they will be considered as delayed. If not, obeying commands is assessed. Patients who can obey commands are evaluated the palapable radial pulse. If the palapable radial pulse is present, this patient is considered as urgent. If the palapable radial pulse is absent, the patient is regarded as immediate. Patients who cannot obey commands are assessed the breathes with open airway. Patients without breathes are labeled as unsalvageable. Otherwise, the patient is considered as immediate (**Figure 3**). Compared with other triage tools, such as START and SALT, Careflight is easy to perform in short triage time.

Garner *et al.* conducted a retrospective analysis of 1144 adult patients to compare the sensitivity and specificity in triage tools [15]. As a result, there was no significant difference between Careflight triage and other triage tools. Careflight has been used in several MCIs. In 2002, Careflight was applied after the Bali bombing to transport pateints from Bali to Australia [41]. However, the parameters of Careflight triage tool such as accuracy rate, triage time and over-and undertriage rate were not evaluated in triage of this MCI. The transport bombings in London on 7th July 2005 caused a great number of casualties, Challen and Walter compared START, Manchester Sieve (Triage Sieve) and CareFlight triage systems in this MCI [42]. They found that Careflight was an efficiency triage tool as well as START and Manchester Sieve. Vassallo and colleagues performed a comprehensive analysis to compare the efficiency of Triage Sieve, Military Sieve, Modified Military Sieve, START and Careflight [43]. The sensitivity and specificity of Careflight was 44.7% (95% CI 37.8% - 51.6%) and 91.9% (95% CI 87.3% - 96.5%), respectively.

3.5. Triage Sieve (TS) and Pediatric Triage Tape (PTT)

Triage Sieve (TS) has been accepted by prehospital providers in UK and Australia. TS is a part of the Major Incident Medical Management and Support (MIMMS) course for healthcare providers introduced by Hodgetts and Mackway-Jones [44]. Similar to START, TS assesses the ability of movement first, and then breath, respiratory rate and capillary refill. The severity of patients is classified as 4 levels: Priority 1 (immediate), Priority 2 (urgent), Priority 3 (delayed) and deceased. The procedure of TS is show in **Figure 4**. In order to improve the accuracy rate of TS, training course and simulation are necessary for paramedic. As a component of MIMMS, TS had been studied in Australia widely [45]. Cuttance *et al.* performed a study and found that the use of an aide-memoir could improve the triage accuracy rate of TS [46]. Horne and colleagues compared the sensitivity and specificity of TS and its military version (Military Sieve) [47]. This analysis suggested that the sensitivity and specificity of TS were 53% and 88%. In 2004, Malik *et al.* conducted a triage in a train accident with 122 injured patients by using TS triage tool. As a result, 14 patients were scored as Priority 1, 21 were Priority 2, and 7 were Priority 3. Consequently, there was only one death after the triage.

Paediatric Triage Tape (PTT, the paediatric version of TS) was a vinyl waterproof tape developed by Hodgetts *et al.* [48]. It is easy to learn and a useful triage tool for paediatric patients in MCI. The parameters in PTT are the same as the adult version and they are associated with child's height (blocked as <50 cm, 50 - 80 cm, 80 - 100 cm, 100 - 140 cm, and ≥140 cm). To valid the sensitivity, specificity, overtriage, and undertriage rates of PTT, Wallis and Carley analyzed the efficietncy of PTT. They found that the PTT had poor sensitivity of 37.8% with specificity of 98.6%. Besides, the overtriage rate was 38.8% and the undertriage rate was 3.5%. This study suggested that PTT was not an ideal triage tool for children in MCI.

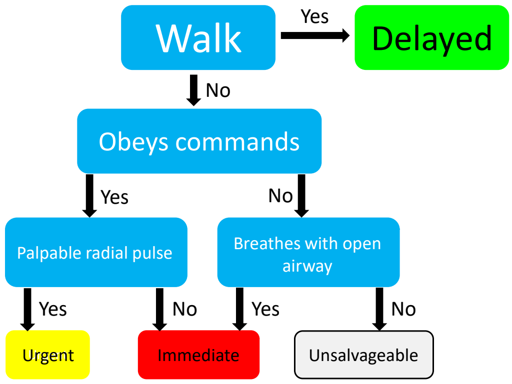

Figure 3. The procedure of Careflight triage.

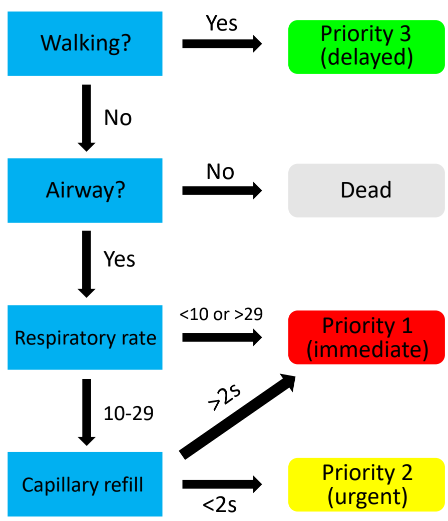

Figure 4. The procedure of Triage Sieve (TS).

4. Conclusions

Triage is the first step of medical rescue in MCI. It demands a comprehensive medicine care in rapid response to unexpected catastrophe. When a MCI occurs, available medical resources are limited and all the local health systems will be overwhelmed by mass victims. Thus, the utmost priority of triage is to allocate the medical resources reasonably in a short time, especially when medical resources are constrained. To date, there are several triage systems applied in the world, such as START, SALT, STM, Careflight and TS. All the triage tools are majorly to assess the vital signs of victims by simple physical examination. These triage tools play important roles in MCI.

However, only few triage systems are developed based on scientific data and most of triage systems are validated by simulations. Therefore, the application, reliability, sensitivity and specificity of existing triage tools require to be validated in the real condition of MCI. Furthermore, due to the difference between triage tools used in different countries, international cooperation is demanded for more highly organized mass-casualty medical responses.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Navin, D.M., Sacco, W.J. and McCord, T.B. (2010) Does START Triage Work? The Answer Is Clear! *Annals of Emergency Medicine*, **55**, 579-581. https://doi.org/10.1016/j.annemergmed.2009.11.031

[2] Robertson-Steel, I. (2006) Evolution of Triage Systems. *Emergency Medicine Journal*, **23**, 154-155. https://doi.org/10.1136/emj.2005.030270

[3] Bhalla, M.C., Frey, J., Rider, C., Nord, M. and Hegerhorst, M. (2015) Simple Triage Algorithm and Rapid Treatment and Sort, Assess, Lifesaving, Interventions, Treatment, and Transportation Mass Casualty Triage Methods for Sensitivity, Specificity, and Predictive Values. *The American Journal of Emergency Medicine*, **33**, 1687-1691. https://doi.org/10.1016/j.ajem.2015.08.021

[4] Falzone, E., Pasquier, P., Hoffmann, C., Barbier, O., Boutonnet, M., Salvadori, A., Jarrassier, A., Renner, J., Malgras, B. and Mérat, S. (2017) Triage in Military Settings. *Anaesthesia Critical Care & Pain Medicine,* **36**, 43-51. https://doi.org/10.1016/j.accpm.2016.05.004

[5] Cook, L. (2001) The World Trade Center Attack. The Paramedic Response: An Insider's View. *Critical Care*, **5**, Article No. 301. https://doi.org/10.1186/cc1054

[6] Grech, V. and Zammit, D. (2017) A Review of Terrorism and Its Reduction of the Gender Ratio at Birth after Seasonal Adjustment. *Early Human Development*, **115**,

2-8. https://doi.org/10.1016/j.earlhumdev.2017.08.004

[7] Chen, J.H., Yang, J., Yang, Y. and Zheng, J.C. (2015) Mass Casualty Incident Primary Triage Methods in China. *Chinese Medical Journal*, **128**, 2664-2671. https://doi.org/10.4103/0366-6999.166030

[8] Khan, A.S. and Lurie, N. (2014) Health Security in 2014: Building on Preparedness Knowledge for Emerging Health Threats. *Lancet*, **384**, 93-97. https://doi.org/10.1016/S0140-6736(14)60260-9

[9] VandenBerg, S.L. and Davidson, S.B. (2015) Preparation for Mass Casualty Incidents. *Critical Care Nursing Clinics of North America*, **27**, 157-166. https://doi.org/10.1016/j.cnc.2015.02.008

[10] Almogy, G., Belzberg, H., Mintz, Y., Pikarsky, A.K., Zamir, G. and Rivkind, A.I. (2004) Suicide Bombing Attacks: Update and Modifications to the Protocol. *Annals of Surgery*, **239**, 295-303. https://doi.org/10.1097/01.sla.0000114014.63423.55

[11] Propper, B.W., Rasmussen, T.E., Davidson, S.B., Vandenberg, S.L., Clouse, W.D., Burkhardt, G.E., Gifford, S.M. and Johannigman, J.A. (2009) Surgical Response to Multiple Casualty Incidents Following Single Explosive Events. *Annals of Surgery*, **250**, 311-315. https://doi.org/10.1097/SLA.0b013e3181ae34a2

[12] Horton R. (2017) Offline: Terrorism and Syria—"A Crisis of the World". *Lancet*, **390**, 924. https://doi.org/10.1016/S0140-6736(17)32347-4

[13] Carles, M., Levraut, J., Gonzalez, J.F., Valli, F., Bornard, L. and 16 Authors, A Full List of Authors Is Available in the Appendix (2016) Mass Casualty Events and Health Organisation: Terrorist Attack in Nice. *Lancet*, **388**, 2349-2350. https://doi.org/10.1016/S0140-6736(16)32128-6

[14] Qiao, X., Du, J., Lugli, S., Ren, J., Xiao, W., Chen, P. and Tang, Y. (2016) Are Climate Warming and Enhanced Atmospheric Deposition of Sulfur and Nitrogen Threatening Tufa Landscapes in Jiuzhaigou National Nature Reserve, Sichuan, China? *The Science of the Total Environment*, **562**, 724-731. https://doi.org/10.1016/j.scitotenv.2016.04.073

[15] Garner, A., Lee, A., Harrison, K. and Schultz, C.H. (2001) Comparative Analysis of Multiple-casualty Incident Triage Algorithms. *Annals of Emergency Medicine*, **38**, 541-548. https://doi.org/10.1067/mem.2001.119053

[16] Arnold, T., Cleary, V., Groth, S., Hook, R., Jones, D. and Super, G. (1994) START. Newport Beach Fire and Marine Department, Newport Beach.

[17] Gebhart, M.E. and Pence, R. (2007) START Triage: Does It Work? *Disaster Management & Response*, **5**, 68-73. https://doi.org/10.1016/j.dmr.2007.05.002

[18] Badiali, S., Giugni, A. and Marcis, L. (2017) Testing the START Triage Protocol: Can It Improve the Ability of Nonmedical Personnel to Better Triage Patients during Disasters and Mass Casualties Incidents? *Disaster Medicine and Public Health Preparedness*, **11**, 305-309. https://doi.org/10.1017/dmp.2016.151

[19] Kahn, C.A., Schultz, C.H., Miller, K.T. and Anderson, C.L. (2009) Does START Triage Work? An Outcomes Assessment after a Disaster. *Annals of Emergency Medicine*, **54**, 424-430.e1. https://doi.org/10.1016/j.annemergmed.2008.12.035

[20] Romig L.E. (2002) Pediatric Triage. A System to JumpSTART Your Triage of Young Patients at MCIs. *JEMS*, **27**, 52-58+60-63.

[21] Wallis, L.A. and Carley, S. (2006) Comparison of Paediatric Major Incident Primary Triage Tools. *Emergency Medicine Journal*, **23**, 475-478. https://doi.org/10.1136/emj.2005.032672

[22] Claudius, I., Kaji, A.H., Santillanes, G., Cicero, M.X., Donofrio, J.J., Gausche-Hill,

M., Srinivasan, S. and Chang, T.P. (2015) Accuracy, Efficiency, and Inappropriate Actions Using JumpSTART Triage in MCI Simulations. *Prehospital and Disaster Medicine*, **30**, 457-460. https://doi.org/10.1017/S1049023X15005002

[23] Báez, A.A., Sztajnkrycer, M.D., Smester, P., Giraldez, E. and Vargas, L.E. (2005) Effectiveness of A Simple Internet-Based Disaster Triage Educational Tool Directed Toward Latin-American EMS Providers. *Prehospital Emergency Care*, **9**, 227-230. https://doi.org/10.1080/10903120590924555

[24] Andreatta, P.B., Maslowski, E., Petty, S., Shim, W., Marsh, M., Hall, T., Stern, S. and Frankel, J. (2010) Virtual Reality Triage Training Provides a Viable Solution for Disaster-Preparedness. *Academic Emergency Medicine*, **17**, 870-876. https://doi.org/10.1111/j.1553-2712.2010.00728.x

[25] Fink, B.N., Rega, P.P., Sexton, M.E. and Wishner, C. (2018) START versus SALT Triage: Which Is Preferred by the 21st Century Health Care Student? *Prehospital and Disaster Medicine*, **33**, 381-386. https://doi.org/10.1017/S1049023X18000547

[26] Arshad, F.H., Williams, A., Asaeda, G., Isaacs, D., Kaufman, B., Ben-Eli, D., Gonzalez, D., Freese, J.P., Hillgardner, J., Weakley, J., Hall, C.B., Webber, M.P. and Prezant, D.J. (2015) A Modified Simple Triage and Rapid Treatment Algorithm from the New York City (USA) Fire Department. *Prehospital and Disaster Medicine*, **30**, 199-204. https://doi.org/10.1017/S1049023X14001447

[27] Lee, J.S. and Franc, J.M. (2015) Impact of A Two-step Emergency Department Triage Model with START, Then CTAS, on Patient Flow during A Simulated Mass-Casualty Incident. *Prehospital and Disaster Medicine*, **30**, 390-396. https://doi.org/10.1017/S1049023X15004835

[28] Lerner, E.B., Schwartz, R.B., Coule, P.L., Weinstein, E.S., Cone, D.C., Hunt, R.C., Sasser, S.M., Liu, J.M., Nudell, N.G., Wedmore, I.S., Hammond, J., Bulger, E.M., Salomone, J.P., Sanddal, T.L., Markenson, D. and O'Connor, R.E. (2008) Mass Casualty Triage: An Evaluation of the Data and Development of A Proposed National Guideline. *Disaster Medicine and Public Health Preparedness*, **2**, S25-S34. https://doi.org/10.1097/DMP.0b013e318182194e

[29] Bazyar, J., Farrokhi, M. and Khankeh, H. (2019) Triage Systems in Mass Casualty Incidents and Disasters: A Review Study with a Worldwide Approach. *Open Access Macedonian Journal of Medical Sciences*, **7**, 482-494. https://doi.org/10.3889/oamjms.2019.119

[30] Cone, D.C., Serra, J., Burns, K., MacMillan, D.S., Kurland, L. and Van Gelder, C. (2009) Pilot Test of the SALT Mass Casualty Triage System. *Prehospital Emergency Care*, **13**, 536-540. https://doi.org/10.1080/10903120802706252

[31] Lerner, E.B., Schwartz, R.B., Coule, P.L. and Pirrallo, R.G. (2010) Use of SALT Triage in a Simulated Mass-Casualty Incident. *Prehospital Emergency Care*, **14**, 21-25. https://doi.org/10.3109/10903120903349812

[32] Cone, D.C., Serra, J. and Kurland, L. (2011) Comparison of the SALT and Smart Triage Systems Using a Virtual Reality Simulator with Paramedic Students. *European Journal of Emergency Medicine*, **18**, 314-321. https://doi.org/10.1097/MEJ.0b013e328345d6fd

[33] Lee, C.W., McLeod, S.L. and Peddle, M.B. (2015) First Responder Accuracy Using SALT after Brief Initial Training. *Prehospital and Disaster Medicine*, **30**, 447-451. https://doi.org/10.1017/S1049023X15004975

[34] Nilsson, A., Åslund, K., Lampi, M., Nilsson, H. and Jonson, C.O. (2015) Improved and Sustained Triage Skills in Firemen after a Short Training Intervention. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, **23**, Article No. 81. https://doi.org/10.1186/s13049-015-0162-7

[35] Jones, N., White, M.L., Tofil, N., Pickens, M., Youngblood, A., Zinkan, L. and Baker, M.D. (2014) Randomized Trial Comparing Two Mass Casualty Triage Systems (JumpSTART versus SALT) in a Pediatric Simulated Mass Casualty Event. *Prehospital Emergency Care*, **18**, 417-423. https://doi.org/10.3109/10903127.2014.882997

[36] Sacco, W.J., Navin, D.M., Fiedler, K.E., Waddell 2nd, R.K., Long, W.B. and Buckman Jr., R.F. (2005) Precise Formulation and Evidence-Based Application of Resource-Constrained Triage. *Academic Emergency Medicine*, **12**, 759-770. https://doi.org/10.1197/j.aem.2005.04.003

[37] Gallizzi, E.L., Elam, J. and Sprague, R.H. (1985) Computer Implementation of Severity Scores for Civilian Trauma Patient and Naval Combat Casualty Care. *Proceedings of the* 18*th Hawaii International Conference on System Sciences*, Honolulu, 2-4 January 1985, 79-80.

[38] Sacco, W.J., Navin, D.M., Waddell 2nd, R.K., Fiedler, K.E., Long, W.B. and Buckman Jr., R.F. (2007) A New Resource-Constrained Triage Method Applied to Victims of Penetrating Injury. *The Journal of Trauma*, **63**, 316-325. https://doi.org/10.1097/TA.0b013e31806bf212

[39] Jain, T.N., Ragazzoni, L., Stryhn, H., Stratton, S.J. and Della Corte, F. (2016) Comparison of the Sacco Triage Method Versus START Triage Using a Virtual Reality Scenario in Advance Care Paramedic Students. *Canadian Journal of Emergency Medicine*, **18**, 288-292. https://doi.org/10.1017/cem.2015.102

[40] Jenkins, J.L., McCarthy, M.L., Sauer, L.M., Green, G.B., Stuart, S., Thomas, T.L. and Hsu, E.B. (2008) Mass-Casualty Triage: Time for an Evidence-Based Approach. *Prehospital and Disaster Medicine*, **23**, 3-8. https://doi.org/10.1017/S1049023X00005471

[41] Tran, M.D., Garner, A.A., Morrison, I., Sharley, P.H., Griggs, W.M. and Xavier, C. (2003) The Bali Bombing: Civilian Aeromedical Evacuation. *The Medical Journal of Australia*, **179**, 353-356. https://doi.org/10.5694/j.1326-5377.2003.tb05592.x

[42] Challen, K. and Walter, D. (2013) Major Incident Triage: Comparative Validation Using Data from 7th July Bombings. *Injury*, **44**, 629-633. https://doi.org/10.1016/j.injury.2012.06.026

[43] Vassallo, J., Horne, S., Ball, S. and Whitley, J. (2014) UK Triage the Validation of A New Tool to Counter an Evolving Threat. *Injury*, **45**, 2071-2075. https://doi.org/10.1016/j.injury.2014.08.053

[44] Morrison, L.J. (1997) Major Incident Medical Management and Support: The Practical Approach. *Canadian Medical Association Journal*, **156**, 78-79.

[45] Sammut, J., Cato, D. and Homer, T. (2001) Major Incident Medical Management and Support (MIMMS): A Practical, Multiple Casualty, Disaster-Site Training Course for All Australian Health Care Personnel. *Emergency Medicine*, **13**, 174-180. https://doi.org/10.1046/j.1442-2026.2001.00206.x

[46] Cuttance, G., Dansie, K. and Rayner, T. (2017) Paramedic Application of a Triage Sieve: A Paper-Based Exercise. *Prehospital and Disaster Medicine*, **32**, 3-13. https://doi.org/10.1017/S1049023X16001163

[47] Horne, S., Vassallo, J., Read, J. and Ball, S. (2013) UK Triage—An Improved Tool for an Evolving Threat. *Injury*, **44**, 23-28. https://doi.org/10.1016/j.injury.2011.10.005

[48] Hodgetts, T.J., Hall, J., Maconochie, I. and Smart C. (1998) Pediatric Triage Tape. *Prehospital Immediate Care*, **2**, 155-159.