Triage Systems in Mass Casualty Incidents and Disasters: A Review Study with A Worldwide Approach

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Abstract

BACKGROUND: Injuries caused by emergencies and accidents are increasing in the world. To prioritise patients to provide them with proper services and to optimally use the resources and facilities of the medical centres during accidents, the use of triage systems, which are one of the key principles of accident management, seems essential.

AIM: This study is an attempt to identify available triage systems and compare the differences and similarities of the standards of these systems during emergencies and disasters through a review study.

METHODS: This study was conducted through a review of the triage systems used in emergencies and disasters throughout the world. Accordingly, all articles published between 1990 and 2018 in both English and Persian journals were searched based on several keywords including Triage, Disaster, Mass Casualty Incidents, in the Medline, Web of Science, PubMed, Cochrane Library, Science Direct, Google scholar, Irandoc, Magiran, Iranmedex, and SID databases in isolation and in combination using both and/or conjunctions.

RESULTS: Based on the search done in these databases, twenty different systems were identified in the primary adult triage field including START, Homebush triage, Standard, Sieve, CareFlight, STM, Military, CESIRA Protocol, MASS, Revers, CBRN Triage, Burn Triage, META Triage, Mass Gathering Triage, Swift Triage, MPTT, TEWS Triage, Medical Triage, SALT, mSTART and ASA. There were two primary triage systems including Jump START and PTT for children, and also two secondary triage systems encompassing SAVE and SORT identified in this respect: ES1 and CRAMS were two other cases distinguished for hospital triage systems.

CONCLUSION: There are divergent triage systems in the world, but there is no general and universal agreement on how patients and injured people should be triaged. Accordingly, these systems may be designed based on such criteria as vital signs, patient's major problems, or the resources and facilities needed to respond to patients' needs. To date, no triage system has been known as superior, specifically about the patients' clinical outcomes, improvement of the scene management or allocation of the resources compared to other systems. Thus, it is recommended that different countries such as Iran design their triage model for emergencies and disasters by their native conditions, resources and relief forces.

Introduction

One of the symptoms of disasters is that the immediate needs of the community affected exceed the available resources, so the question is how these resources should be used to have the best outcome for the people. Triage is the allocation of limited resources during a disaster. Although the concept of triage applies to all resources, "patient care" is the most commonly discussed field for which the notion of triage is used [1]. Triage is one of the key principles of the effective management of major emergencies [2]. Triage is derived from the French word "trier", which means separating, categorising or classifying, and refers to the categorization, classification, and prioritization of patients and injured people, based on their urgent need for treatment [1], [3]. The process of triage allows the respondents of disaster, who do not have enough resources to treat everyone, to prioritize care services, so that most services are provided to the greatest number of injured people, and this is essentially the philosophy of doing triage in disasters and mass casualty incidents [1], [3], [4]. Triage is usually performed at three stages: the primary triage that is carried out at the scene of the incident by an emergency technician aims at the prompt assessment of the injured person and rapid transfer to the treatment center. Secondary triage which is used when, due to the large extent of the incident and lack of resources in the pre-hospital, the transmission of the injured person has been prolonged in the scene.

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In these cases, triage will be done by an emergency doctor or surgeon as soon as the injured person arrives at the hospital. The third triage is performed to prioritise and decide on receiving care services, including transferring to the operating room or the intensive care unit. This step will be done by a surgeon or a critical care specialist [1, 5].

The triage system is used by individuals to determine which groups of the patients should receive treatment and care services based on their clinical status, the prognosis of disease and available resources [6].

Methods

The present study was conducted through a review of triage in disasters and mass casualty incidents, with the aim of identifying triage systems, relevant criteria, and the order of these criteria all over the world. Accordingly, all articles published in English and Persian language journals between 1990 and 2018 were searched based on several keywords including Triage, Disaster, Mass Casualty Incidents in the MedLib, Scopus, Web of Science, PubMed, Cochrane Library, Science Direct, Google scholar, Irandoc, Magiran, Iranmedex, and SID databases in separation and combination using and/or conjunctions. Based on this, all English and Persian articles conducted in the world, which discussed triage systems and their algorithms and also were of desirable quality, were included in the study. Accordingly, poor quality studies, those who discussed triage, but did not provide the information needed for triage algorithms and their criteria, or studies that merely discussed the accuracy and the testing of triage systems were excluded from the study.

Results

Based on the search done, triage systems were grouped into three classes including primary triage systems (adults and children), secondary and hospital triage systems. In this study, twenty primary adult triage systems, two primary children triage systems and two secondary triage systems were identified. Primary triage systems that have been identified include START, Homebush triage Standard, Sieve, CareFlight, STM, Military, CESIRA Protocol, MASS, Revers, CBRN Triage, Burn Triage, META Triage, Mass Gathering Triage, SwiFT Triage, MPTT, TEWS Triage, Medical Triage, SALT, mSTART, ASAIV. The triage systems identified for children were Jump START and PTT. Moreover, SAVE and Sort triage systems were identified as far as the secondary triage is taken into consideration. In the hospital triage systems, the ESI triage model amongst five-level triage systems, which has a higher level of validity and reliability, and the CRAMS triage system used to triage patients in the emergency units of the hospitals were identified. These systems are described according to the following algorithm.

**START triage system**

This system is the most commonly used triage system in the United States. This system is also used in Canada and parts of Australia and the Israeli-occupied territories. It was created by the Newport Beach Fire Department and Hoag Hospital in California in 1980 [1]. In this system, all injured adults older than 8 years are evaluated, based on the algorithm of the system in 60 seconds or less (preferably 30 seconds). In this system, the criteria including the ability to walk, respiratory rate, capillary filling, radial pulse and obeying the commands are used. By examining each criterion, the patient will be marked by one of the red, yellow, green and black tags (Figure 1) [7].

Since the capillary filling criterion in the dark and cold environments in emergencies and disasters is not an appropriate reflection of the circulatory system, this criterion has been omitted in the modified model of the triage system (MSTART) (Figure 2). The only therapeutic measures allowed in this method are opening the airway of the patient and controlling the bleeding by direct pressure on the site of the bleeding.

**Reverse Triage**

Reverse triage is a method that is commonly used during emergencies and disasters. In reverse triage, injured people with fewer damages and minor injuries are at the priority of receiving services. This is also used in cases, where the treatment team or soldiers, during the war, are injured.
Moreover, this kind of triage system is used in the disaster and emergencies, where medical resources are limited, with the aim of returning people as quickly as possible and helping other people [3]. Reverse triage is also a way to increase the capacity of the emergency unit of the hospital during disasters. Accordingly, those patients with mild injuries and those supposed to be without any medical complications for at least 96 hours after discharge are at the top of the discharge list [8].

**Military Triage**

The main goal of the military triage is to treat and return more injured soldiers to the battlefield. In this method, immediate and rapid classification of the injured people is based on the type and severity of the injury, the probability of survival, as well as the priority of treatment in order to provide the best health care services for the largest number of people [1], [9], [10]. Most military triage systems use T (Treatment) codes including T1, T2, T3, T4 and dead to classify the injured individuals, while others use P (Priority) codes including P1, P2, P3 and P-Hold [11].

**MASS triage (Move, Assess, Sort, Send)**

This system is a disaster triage system used in the United States. Although this system is based on the START triage system, it does classify the injured people before individual examination [1]. This includes four stages of moving, evaluating, classifying and transferring. This system, whose algorithm is very similar to the SALT triage method, has four tags: red, yellow, green and black (Figure 3). Allowed therapeutic measures in this model include opening the airway, controlling bleeding, Antidote injections and chest decompression. After performing the actions for this red group, then the yellow and green groups are considered, respectively [1], [12].

**Sieve Triage**

Similar to the START method, this method, which is used in parts of Europe, Australia, and the United Kingdom, first uses the walking filter to examine the injured individual, and uses four tags encompassing red, yellow, green and black tags to classify the injured patients (Figure 4) [13], [14], [15].

**CESIRA Protocol**

This method was designed in 1990. In this method, the injured people fall into three red, yellow
and green classes. The red class includes people, who are unconscious and in shock, have bleeding, and ineffective breathing. The yellow class involves patients with fractures of the bones and other injuries, and the green class includes injured people, who can walk [1], [4].

**Homebush Triage**

This method was designed in 1999 in Australia, which attempts to integrate the triage protocols in that country [16]. This method is based on START and SAVE triage systems [17] and includes 5 classes of triage (Table 1). Although the application of this system was documented in 2002, there are no data on its accuracy and its impact on specific consequences like other triage systems [18].

| Table 1: Classification of the injured people according to the Homebush Triage Standard |
|---------------------------------|---------------------------------|---------------------------------|
| **Homebush Triage Standard**    | **RED** (ALPHA)                 | **YELLOW** (BRAVO)              |
| **Urgent**                      | Immediate                       | Non-ambulatory patients who do not meet black, white, or red criteria. |
|                                 | Respirations more than 30 breaths/min. |                               |
|                                 | No palpable radial pulse.        |                               |
| **GREEN**                       | Non-urgent                       | Able to walk to a designated safe area for further assessment. |
|                                 | Dying                             | Dying patients: may have a pulse, but no spontaneous respirations. |
| **WHITE**                       | Dying                             | I am not breathing despite one attempt to open the airway. |
| **BLACK**                       | Dead                              |                                 |
| **ECHO**                        |                                   |                                 |

**CareFlight Triage**

This method is a tool for rapid triage in mass casualty incidents, in which such criteria as walking ability, obeying the commands, palpable radial pulses, and airway respiration are evaluated (Figure 5). The injured people are placed in four urgent (red), emergency (yellow), delayed (green) and non-salvageable (black) classes.

The noteworthy point is that in this method the criterion of obeying the commands is examined before the evaluation of breathing and pulse rate. This method is one of the fastest triage methods, which takes only 15 seconds to test each patient [3], [14].

**SALT triage (Sort, Assess, lifesaving intervention, Treatment/Transport)**

This is one of the latest triage systems, which was introduced and registered by the CDC in 2008 as a national standard for mass casualty incidents. This process begins by categorising the patients into three groups based on simple voice commands.

![Figure 5: Careflight Triage Algorithm (Garner, 2001) [14]](image)

![Figure 6: SALT Triage Algorithm (Bhalla, 2015) [7]](image)

**Triage in special circumstances of the CBRN (Chemical, Biological, Radiological, Nuclear)**

Although up to now, damages are often caused by explosion, collision or collapse of buildings in most disasters, there are also other probable scenarios, where damages are caused by chemical, biological, radiation, nuclear, and hazardous materials, which have occurred so far all over the world. It is very difficult to design a comprehensive triage system, which is easy to use and scientifically valid for all hazards. In some resources, it is recommended that, under certain circumstances such as incidents of weapons of mass destruction or hazardous materials, in case of occurring mass casualty incidents, a START-based triage algorithm, with a consideration of a series of special measures based on the type of the incident, such as decontamination, use of personal protective equipment and some special clinical considerations should be used. The SALT triage system is proposed with the aim of establishing a comprehensive method for the triage of injured patients at all hazards, but there is little evidence of its effectiveness in CBRN conditions [19].

The first includes the group of the injured people, who can walk to the area requested by the
person performing the triage. The second group is the injured people, who only can shake their hands or feet, and the third group consists of the injured patients, who have no movement or show life-threatening conditions. This third group will be the first group of individual evaluations. The actions recommended in this kind of triage include airway opening, external bleeding control, Antidote injections for some poisonings, and needle thoracostomy for pneumothorax (Figure 6) [4], [7].

**STM (Sacco Triage Method)**

This method, which is designed based on a mathematical model and is a numerical triage method, considers the resources, based on time and facilities, in addition to the triage of the injured people. In this method, based on the physiological criteria including respiration, pulse and motor response, the injured people are scored, and by the acquired score, the probability of the survival of the injured person or his death is calculated. The first group of the injured people, with a score of 0-4, is tagged with a black label. The injured people of the second group, who have a score ranging from 5 to 8 are likely to survive through interventions. And the patients of the third group with a score of 9 to 12, have a survival probability rate of more than 90 per cent. After rating the injured people, their situation is announced to the incident command and subsequently, hospital resources are considered for the treatment (Figure 7) [3], [20], [21].

**Burn Triage**

In this method, which is used to prioritise injured persons in burn events, the classification of the injured people is based on the severity and level of the burn (Table 2) [22], [23].

| Category   | Profile                                                                 |
|------------|--------------------------------------------------------------------------|
| Green group| First- degree and superficial burns                                      |
|            | Burns above 30% in people over 5 and under 60 years old                  |
| Yellow group| Burns above 30% in people over 5 and under 60 years old                  |
| Red group  | Second- degree burns in head and neck, genital area and joints          |
|            | Third- degree burns in an anatomical region of the body                  |
|            | Burn in people under 5 years of age and over 60 years of age            |
|            | Burn in pregnant women, people with underlying conditions with second- degree burns more than 10%, people with second- degree burns above 30% |

**META Triage**

This method has 4 steps, in which the first and second steps are called Stabilization Triage, and the third and fourth steps are named Evacuation Triage.

In each step, certain actions must be performed according to the algorithm. In the first step, the injured people are placed on the red, yellow, and green classes according to the A, B, C, D and E criteria, and at the next step, the injured individuals are classified based on the evaluation of the surgery and injuries (Figure 8, and 9) [24].

**MASS Gathering Triage**

This method is a proposed triage tool for the Australian context in mass casualty incidents that can be used for first responders (Table 3) [25].

| Table 3: Classification of the patients in the Mass Gathering Triage (Cannon, 2017) [25] |
SWIFT Triage (Senior, Without, Families, Team)

This method is a triage tool for disadvantaged older adults during disasters designed to quickly identify the needs of this specific group [26]. This method is designed at three levels and at each level specific actions are taken as shown in Figure 10.

Medical Triage Protocol

In this protocol, the walking ability criterion is initially controlled, and those who can walk are classified in the green group. Then, other criteria such as the level of consciousness, arterial bleeding, shock, breathlessness, fractures and injuries of the head and spine, and ultimately pathologies such as myocardial infarction, poisoning, burns, hypothermia, and chest pain are checked and the patient is tagged as red or yellow according to the following algorithm (Figure 11) [27].

MPTT Triage (Modified Physiological Triage Tool)

The method has four tags including red, yellow, green and black, and the injured patients are assessed based on the ability to walk, respiration, pulse and GCS criteria (Figure 13) [2].

ASA V triage system

Amberg-Schwandorf Algorithm for Primary Triage

In this method, which is considered a primary triage system, the injured individuals are placed in four different classes encompassing red, yellow, green and black. Accordingly, the injured patient is placed in the black class, when he suffers fatal injuries.
injuries. In this method, no respiratory rate is considered for breathing. Instead, some criteria for respiratory distress, such as airway obstruction, bradypnea, apnea, dyspnée, tachypnea and cyanosis, are controlled (Figure 14) [30].

**Smart Triage System**

This method of triage is similar to the START triage system. In this system, it is highlighted that if it is not possible to examine the capillary filling criterion, the radial pulse should be controlled. The injured people are also classified into four categories: red, yellow, green, and black according to the algorithm that shown in Figure 15 [31].

**Tactical Triage**

In this method of triage, the injured individuals are placed into four classes of green, red, yellow and black (Figure 16). The green group consists of patients, who can walk or have mild damages. The delayed or yellow group includes those patients, who may need surgery, but their general condition allows them to receive any medical or surgical operation with delay and without threatening their life. The immediate or red group includes people, who need immediate medical intervention, including rescue and surgical procedures. The key to the success of the triage is the rapid identification of people with a red tag [32].

**Children’s triage systems**

*Why do we need children’s triage systems?*

There are important and significant physiological and anatomical differences between children and adults, which highlights the need for children’s triage systems. Children are more susceptible to head injury, airway obstruction and hypothermia than adults.

Moreover, in children, the respiratory tract is preceded by heart failure. Children have fewer blood counts than adults, and younger children may not have the ability to walk, communicate verbally, and collaborate properly [1]. Two types of these systems have been identified for children, which include Jump START and Pediatric Triage Tape (PTT) [4].
The Jump START triage system

This technique was designed by Dr Romig in 1995 as a tool for the triage of the children under the age of 8, and in 2001, some modifications were made to it, based on the principles of the START triage system [33]. These changes were based on three main differences between adults and children, namely the higher probability of the respiratory failure in children than adults, the number of different breath rates in children, and the inability of the young children to follow verbal commands. In this system, the AVPU was used to assess the level of the children's consciousness, instead of the obeying the commands criterion used in the START triage system (Figure 17) [21].

PTT triage system (Pediatric Triage Tape)

There are three guidelines for this method, based on the height and weight of the infants and children. The first instruction is for the babies with a height of 50 to 80 cm (weighing 3 to 10 kg) (Figure 18). If the child cries and moves his body purposefully, he will be placed in the third priority (delayed). It is necessary to open the baby's airway, in case he does not cry, move and breathe, and if respiration starts after this action, he will be placed at the priority (emergency). Otherwise he would be placed at the last priority (dead). In this guideline, the normal ranges of breathing and pulse are between 20-50 and 90-180 times per minute, respectively. By examining these criteria, the baby is placed in either red, yellow, green or black classes.

Secondary triage systems

In cases, where the number of the injured people is high, and it is not possible to transfer all the patients to medical centres or hospitals or because of the large extent of the incident and lack of resources in the pre-hospital, the process of transferring all patients from the scene would be prolonged, it is probable that a group of the injured people remains at the disaster scene for a long time. Secondary triage systems are used in these cases as well as at the arrival of the injured patients to the emergency unit of the hospital. The two methods of secondary triage include the SAVE and the Sort triage systems [1].

SAVE Triage

The SAVE method (Secondary Assessment Victim Endpoint) is used to diagnose the patients, who take the most out of the existing care services.

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**Table 5: Criteria in SAVE triage**

| Criteria in SAVE Triage: Burn Injury, GCS and MESS |  |
|----------------------------------------|----------------------------------------|
| 1. Burn injury: less than 50% chance of survival | Score 8 or above: Treat better than 50% chance of normal or good neurologic recovery |
| 2. Crush Injury to Lower Extremity: Use the MESS Score | Score 7 or more: amputate |
| 3. Crush Injury to Lower Extremity: Use the MESS Score | Score less than 7: attempt limb salvage |
| Age over than 60 with Inhalational injury | Score 7 or less: comfort care only |
| Age less than 2 with 50% TBSA Burn | Score 7 or less: attempt limb salvage |
| Age more than 60 with 35% TBSA Burn | Score 7 or less: attempt limb salvage |
To determine the survival chances and patient classifications, predictive tools of the patient clinical conditions such as limb rescue score, Glasgow Coma Scale (GCS), and survival rate data after burns are used (Table 5, and 6). The injured people, who cannot survive and cannot be treated at the disaster scene, but can be saved if they reach the hospital, will be tagged with a red label. Those patients, who take the most from the available therapeutic interventions, are marked with a yellow tag. Those injured individuals, who can survive even without medical intervention, are tagged with green labels, and finally, the deceased people are labelled with black colour [1].

### Table 6: MESS score in SAVE triage

| Mangled Extremity Severity Score (MESS) | Patients |
|----------------------------------------|----------|
| Low energy                             | 1        |
| Medium energy                          | 2        |
| High energy                            | 3        |
| Arm fracture                            | 0        |
| Leg fracture                           | 0        |
| Head trauma                            | 1        |
| Shock                                   | 2        |
| Hypothermia                             | 1        |
| Intestinal injury                      | 1        |
| Renal failure                           | 1        |
| Diabetic coma                           | 1        |
| Platelet disorder                      | 2        |
| Pulmonary arrest                        | 2        |
| Advanced trauma                         | 2        |

### CRAMS Triage

Circulation, Respiration, Abdominal and Thorax Exam, Motor Response, Speech

This numerical method of triage, as a part of the hospital triage models, is used in some European and American countries (Figure 20). In this method, each criterion is scored from 0 to 2 points. Then, based on the score obtained, the patient with a score of less than 6 will be placed at the immediate class. An injured patient with a score of 7 is placed in the emergency class, and with a score of 8 to 10, he would be categorised in the delayed class [37].

### Emergency Severity Index (ESI) Triage

The system was designed in late 1990 in the United States by two emergency medical experts named Richard Weurz and David Eitel [38], [39]. This system, not only determines which patient should be checked first but also indicates which levels of facilities and resources are needed to meet the patient's needs (Figure 21).
Table 7: Comparison of the criteria, their priority and range in different triage systems worldwide

| Model         | Components and the criteria of the model according to priority - Descriptions required | Model approach |
|---------------|----------------------------------------------------------------------------------------|----------------|
| START         | 1. Ability to walk 2. Respiration 3. Capillary filling 4. Pulse 5. Obeying the commands | Algorithmic    |
|                | The threshold for respiration is 30 times per minute. The pulse has no range of even boundaries, and only its existence or its absence is evaluated. |
| Jump START    | 1. Ability to walk 2. Respiration 3. Capillary filling 4. Pulse AVPU.5 | Algorithmic    |
|                | Breathing between 15 and 45 is normal. The pulse lacks any range. The AVPU criterion is used instead of obeying the commands criterion. |
| MSTART        | 1. Ability to walk 2. Respiration 3. Pulse 4. Obeying the commands | Algorithmic    |
|                | Capillary filling criterion has been eliminated in this model. Breathing below 30 times is considered normal, but there is no range for the pulse criterion and only its presence or absence is controlled. |
| Medical       | 1. Ability to walk 2. Consciousness 3. Arterial bleeding 4. Shock 5. Respiration 6. Traumatic evaluation | Algorithmic    |
|                | The breathing criterion lacks limits and boundaries. |
| Sieve         | 1. Ability to walk 2. Respiration 3. Capillary filling 4. Pulse | Algorithmic    |
|                | The respiratory range between 10 and 29 is normal, moreover, the normal range for the pulse is 120 times per minute. |
| Careflight     | 1. Ability to walk 2. Obeying the commands 3. Respiration 4. Pulse | Algorithmic    |
|                | In this model, the obeying the commands criterion is controlled prior to the respiration criterion. Respiration and pulse lack any limits or boundaries. |
| Mass          | 1. Ability to walk 2. Respiration | Algorithmic    |
| Gathering      | 3. Pulse 4. Systolic blood pressure 5. Consciousness 6. Temperature and pain | Algorithmic    |
|                | For respiration the range from 10 to 25 and for the pulse criterion the range from 51 to 120, for blood pressure the range of 110 to 180 mm and for the temperature, the range from 35.5 to 38.5 degrees are normal. |

| Model         | Components and the criteria of the model according to priority - Descriptions required | Model Approach |
|---------------|----------------------------------------------------------------------------------------|----------------|
| STM           | 1. Respiration 2. Pulse 3. Mental status | Numerical      |
| MASS          | 1. Ability to walk 2. Respiration 3. Pulse 4. Obeying the commands | Algorithmic    |
|                | There is no boundary or limit for respiration and pulse. The injured people are evaluated based on the ability or inability to walk in three groups. |
| SALT          | 1. Ability to walk 2. Respiration 3. Pulse 4. Obeying the commands | Algorithmic    |
|                | There is no limit and boundary for respiration and pulse. The injured patients are assessed in three groups based on the ability or inability to walk. |
| SAVE          | 1. Ability to walk 2. Respiration 3. Pulse 4. Obeying the commands | Numerical      |
|                | In the injured people with GCS above 8, and in burns under 50%, young people can hope to survive. |
| Sort          | 1. Respiration 2. Systolic blood pressure GCS.3 | Numerical      |
|                | For respiration, the range of 10 to 29 and for blood pressure the range higher than 90 mm Hg and for GCS the range above 13 are normal. |
| Smart         | 1. Ability to walk 2. Respiration 3. Capillary filling 4. Pulse | Algorithmic    |
|                | Breathing below 30 times per minute is normal, but there is no range specified for the pulse, and only its presence or absence is controlled. |
| META          | 1. Respiration 2. Pulse 3. Traumatic evaluation | Numerical      |
|                | Criteria A, B, C and D are controlled but the range for respiration and normal pulse is not specified. |

| Model         | Components and the criteria of the model according to priority - Descriptions required | Model Approach |
|---------------|----------------------------------------------------------------------------------------|----------------|
| Homebush      | 1. Ability to walk 2. Respiration 3. Pulse 4. Obeying the commands | Algorithmic    |
|                | For the respiration criterion, the rate less than 30 times per minute is normal, and there is no specific range for the pulse, and only its presence or absence is controlled. |
| CESPA         | 1. Ability to walk 2. Awareness control 3. Bleeding 4. Shock 5. Respiration 6. Traumatic evaluation | Algorithmic    |
|                | The respiration criterion has no specific range. Only its quality as well as its presence or absence is controlled. |
| PTT           | 1. Ability to walk 2. Respiration 3. Pulse 4. Obeying the commands | Algorithmic    |
|                | Based on the age and weight, the three ranges including 30 to 60, 15 to 40 and 10 to 30 are normal for respiration. The normal ranges for the pulse criteria are also 90 to 180, 80 to 160, and 70 to 140 times per minute. |
| TEWS          | 1. Ability to walk 2. Respiration 3. Pulse 4. Systolic blood pressure 5. Temperature and pain 6. AVPU 7. Traumatic evaluation | Numerical      |
|                | Normal breathing range is 9 to 14 times per minute. The normal range for the pulse criterion is 51 to 100. The normal range for the systolic pressure and temperature is 101 to 199 mmHg and 35 to 38.4, respectively. |
| CRAMS         | 1. Respiration 2. Systolic blood pressure 3. Motor response 4. Verbal response 5. Abdominal assessment | Numerical      |
|                | There is no specific range for breathing, and only the presence or absence of stomach is controlled. The normal systolic pressure is also higher than 100 mm. |
| ASAV          | 1. Ability to walk 2. Fatal injuries 3. Respiration 4. Control of bleeding 5. Pulse 6. Obeying the commands | Algorithmic    |
|                | Breathing and pulse lack any specific range. |
| MPTT          | 1. Ability to walk 2. Respiration 3. Pulse GCS.4 | Algorithmic    |
|                | The respiration rate is considered to be normal from 12 to 22 times per minute, and for pulse criterion, the range of 100 times per minute is normal. For GCS, 14 and higher is the normal range. |
| ESI           | 1. Respiration 2. Pulse 3. SPO2 | Algorithmic    |
|                | There are specific ranges considered for the respiratory and pulse criteria, based on the age range. Moreover, there is a specific range of 92% for the SPO2 criterion. |

The fourth version of the Emergency Severity Index had some modifications and was adopted by the Ministry of Health of Iran as the standard and acceptable method of triage in the emergency department [35]. This system is a useful tool, that can be used in all urban and rural emergency units and general and academic hospitals [38, 39, 40].

**Components and approaches of Triage models**

According to the results, there are two main numerical and algorithmic approaches for triage in the world. In the algorithmic approach, the injured person is placed in a particular class through examining and controlling each criterion and, if that criterion is normal, the next criterion will be evaluated. But in the
Discussion

There are many types of triage systems in the world; however, there is no general or universal consensus on how triage should be performed. As triage is a dynamic procedure, there is no fixed rule for it. Accordingly, these systems may be designed based on such criteria as vital signs, patient’s major problems, or the resources and facilities needed to respond to the patient’s needs. One of the most important features of a standard triage system is its simplicity in performing and reliability [41], [42]. In other words, the most effective triage is a method that is easy for staffs to perform, does not need to classify patients and injured people by complex criteria and at the same time determine the prognosis of the patients at an optimal level.

Because of the specific circumstances of disasters and the constraints for conducting high-quality studies, including randomised, controlled trials in real-word conditions, there are little evidence and information concerning the best method for performing triage and the effectiveness of various types of triage methods [1]. The fact that triage categories should not be considered permanent is of particular importance. After prioritizing, patients may not remain in that particular category during the incident. Therefore, considering that the patient's condition is changing, the re-evaluation of the patient should be done. Given the current congestion of the present-day emergency units, a rapid system for the diagnosis and separation of the acute and injured patients seems to be necessary. Hay in a study, conducted on the improvement of the quality of the emergency services and establishing an emergency triage at the Center of Gambia, showed that the implementation of the plan over the past three years has resulted in the improvement of the services, so that the patients have been classified safely and effectively and checked with the least error [43]. To date, no triage system has been superior specifically in relation to the patient clinical outcomes, improvement in the scene management, or allocation of the resources compared to other systems. But it seems that the use of a standardized and uniform system in one area can result in a better interoperability and mutual understanding between health system staff, when responding to disasters and mass casualty incidents [1]. Triage is an important tool in health management during emergencies and disasters. The absence of a common national and international guideline has led to the confusion of the health system staff [44]. In this regard, different countries have designed their own triage systems, according to their local conditions, their resources and their relief forces. Therefore, considering the conditions and characteristics of Iran, the need to design the national triage method is felt [21]. The selection of precise criteria in triage models can reduce the mortality rate, through placing the injured people in the correct class. Moreover, it helps to allocate the limited resources of the medical centers to be given to the injured patients, who really need these resources.

Conclusion

Considering the diversity of the triage models and the criteria defined for each system in the world, it is recommended that each country, considering the specific circumstances of the region, the diversity of the emergencies and disasters, and the facilities and resources of its centres, choose or propose a model with accurate and appropriate criteria, and test the accuracy of that model in case of scenarios or on actually injured people. Considering the lack of an appropriate triage system in its hospitals, Iran also needs to national a triage system, which can be effectively used during emergencies and disasters.

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