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REVIEW

The SALT and START Triage Systems for Classifying Patient Acuity Level: A Systematic Review

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Abstract

Background: Two common triage systems have been widely used in mass casualty incidents (MCIs) and disaster situations, namely START (simple triage algorithm and rapid treatment) and SALT (sort, assess, lifesaving, intervention, and treatment/transport). There is currently controversy regarding the effectiveness of SALT over the START triage system.
Purpose: This systematic review aims to compare the accuracy of the SALT and START triage systems in disaster and MCI settings.
Methods: The literature was searched using a systematic search strategy for articles published from 2009 to 2020 in the Medline, CINAHL, Web of Science, Scopus, PubMed, ProQuest databases, and the grey literature. This review included simulation-based and medical record-based studies investigating the accuracy and applicability of the SALT and START triage systems in adult and child populations during MCIs and disasters. All types of studies were included. The PRISMA flowchart was used to retain the articles, and the Joanna Briggs Institute critical appraisal tools were used to assess the quality of the reviewed studies.
Results: Of 1,450 articles identified in the search, 10 articles were included. It was found that the START triage system had a wide range and inconsistent levels of accuracy (44% to 94.2%) compared to the SALT triage system (70% to 83%). The under-triage error of the START triage system ranged from 2.73% to 20%, which was slightly lower than the SALT triage system (7.6% to 23.3%). The over-triage error of the START triage system (2% to 53%) was slightly higher than the SALT triage system (2% to 22%). However, the time taken to apply START triage system (70 to 72.18 seconds) was faster than for the SALT triage system (78 seconds).
Conclusion: The START triage system was simpler and faster than SALT. Conversely, the SALT triage system appeared to be slightly more accurate, more consistent, and had a lower rate of under- and over-triage error than START. It appears that neither the SALT nor the START triage system is superior to the other. Further research is needed to establish the most appropriate disaster and MCI triage system, especially for the Indonesian context.

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1. Introduction

Disaster and Mass Casualty Incidents (MCIs) occur in most communities and countries across the globe (Bazyar et al., 2019). A report from the United Nations for Disaster Risk Reduction (2015) stated that, between 1992 and 2012, approximately 4.4 billion people were victims of disaster, and 1.3 billion people died as a result of disaster and MCIs. Furthermore, the damage to infrastructure and humanity was accounted for about AU$3 trillion (United Nations for Disaster Risk Reduction, 2015).

Disasters and MCIs are categorized as large-scale catastrophic events that cause chaos in the community and result in an overwhelming number of victims (Lee, 2010). Therefore, disasters and MCIs affect local health systems and often result in lowering of their capacity to provide services due to inequities and lack of medical resources' availability (Culley & Svendsen, 2014). As a result of such inequities between demand and available resources, mortality and morbidity rates increase (Gaul, 2016). Therefore, the concept of triage, which leads to the immediate sorting of disaster victims, is crucial to identifying people who have the greatest need for immediate medical intervention (Challen & Walter, 2013).

Triage refers to the categorizing or separating victims according to their level of acuity and need for immediate medical assistance (Bhalla et al., 2015). Triage aims to classify patients by determining the severity of their injuries in order to identify the greatest need for interventions among a group of victims (Bazyar et al., 2019). In addition, the purpose of triage in the disaster context is to maximize the number of survivors by identifying those victims who have a greater chance of survival and optimize limited healthcare resources appropriately (Bazyar et al., 2019). Simple Triage Algorithm and Rapid Treatment (START) is a global triage system that is commonly used in disaster and MCI contexts (Bazyar et al., 2019). The START triage system was developed by the Newport Beach Fire and Marine Department and Hoag Hospital in Newport Beach, California, in 1983 (US Department of Health and Human Services, 2019b). This is one of the oldest triage systems currently in use and aims to classify adult victims' levels of acuity into the following four triage categories, such as expectant (black), immediate (red), delayed (yellow), and minor (green) (Bazyar et al., 2019). A variation of START is known as jumpSTART, which was designed for triaging pediatric populations from infancy to 8 years old (US Department of Health and Human Services, 2019b). On the other hand, The Sort, Assess, Lifesaving Intervention, Treatment/Transport (SALT) triage system was established by the United States Centre for Disease Control and Prevention (CDC) in 2008 (US Department of Health and Human Services, 2019a). The SALT triage algorithm is a global sorting system that operates through simple voice commands and movement. The victims are then categorised into three groups based on their responses to voice command and their ability to move (US Department of Health and Human Services, 2019a).

The SALT triage system was developed as a new disaster and MCI triage system due to a lack of evidence regarding the effectiveness and accuracy of other major triage systems, including the START system (Gaul, 2016; Lerner et al., 2010). However, there is currently some controversy regarding the effectiveness of SALT over the START triage system. The SALT triage system is currently coming into question in relation to its accuracy and applicability in classifying patient acuity and achieving the best outcomes for victims of disasters and MCIs. A number of studies have claimed that SALT is more effective than the START triage system, while others have claimed that SALT is not as accurate as START. Therefore, SALT cannot completely replace the START system, despite the known advantages of the SALT model (Bhalla et al., 2015; Claudius et al., 2015; Cross et al., 2015). Therefore, a critical review of the literature on both triage systems is important to identify the accuracy and applicability of both triage systems in classifying levels of patient acuity.

According to Bazyar et al. (2019), many triage systems have been developed. However, no single triage system has been declared as the primary triage system for MCIs. Consequently, in a single MCI, it is possible that care providers will use different triage systems, potentially leading to confusion, delaying treatment, and contributing to increased morbidity and mortality rates (Gaul, 2016). Hence, it is crucial to propose a single model for primary use during MCIs. However, despite the ongoing controversy regarding the efficacy of the two models being explored in this paper, they are both widely used in many countries, including the USA, Canada, and Australia (Bazyar et al., 2019). Adding to the controversy, other studies have claimed that the SALT and START systems potentially lead to under- and over-triage classifications (Bazyar et al., 2019; Bhalla et al., 2015; Claudius et al., 2015; Cross et al., 2015; Fink et al., 2018; Kahn et al., 2010). In the case of MCIs, both under- and over-triage have negative impacts. Over-triage leads to distraction, overuse of resources, and delays in transport to medical services, while under-triage can cause delayed treatment, and therefore increase the risk of morbidity and mortality (Lee, 2010). Hence, through a critical review in the current research, the SALT and START triage systems can be appraised and summarized to determine whether SALT or START should be applied during MCIs. In addition, applying the most effective and accurate disaster and MCI triage system could result in reduced mortality and morbidity rates and could also improve the quality of life for people living in post-MCI and disaster areas. Therefore, there is a particular need for study by a systematic review of how effective and accurate the SALT and START triage systems are in classifying victims' levels of acuity during disasters and MCIs. This review aims to investigate the effectiveness of the START compared to SALT triage systems during disasters and MCIs.

2. Methods

2.1 Research design

This study can be classified as a systematic review due to its identification, selection, appraisal, and synthesis of high-quality research evidence relevant to the research question. According to Bettany-Saltikov (2012), a systematic review includes the identification, selection, appraisal, and synthesis of high-quality research evidence. Polit (2017) also points out that a systematic review is conducted through a rigorous research methodology in response to a specific research question.

2.2 Search methods

The search strategy began with a scoping search in the Google Scholar database to identify as many as keywords relevant to the topic under review as possible. Three concepts were developed: mass casualty incidents (MCIs) and disasters as concept 1, the START and SALT triage systems as concept 2, and level of acuity as concept 3. Each concept includes synonyms and subject headings. The findings were combined using *Boolean* terms (AND, OR, NOT) and subject headings.

The databases searched were Medline, CINAHL, Web of Science, Scopus, PubMed, ProQuest, Google Scholar, and the grey literature, which were published from 2009 to 2020. These databases were relevant to the topic under review and provided health-related journal articles. The relevant studies were selected and reported through the PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis*)* guideline (Bettany-Saltikov, 2012). This searching process was done by two authors (HP and SP).

2.3 Inclusion and exclusion criteria

The inclusion criteria were chosen to focus on the topic under review by the research team to limit bias. This review included studies that were primary qualitative and quantitative research studies, published in English or Indonesian from 2009 to 2020, considered at least a variable related to the implementation, evaluation, or characterisation of the SALT and START triage systems as well as compared the SALT and START triage systems. Studies that duplicated entries in the search results and incomplete studies were excluded.

2.4 Screening of articles

Two authors (HP and SP) separately screened the articles using PRISMA guidelines. The PRISMA guidelines have four phases, identification, screening, eligibility, and articles included (PRISMA, 2015). Any disagreements were discussed between the authors. In the identification phase, there were 1,450 articles retrieved through Google Scholar and 117 articles through database searching. Of these, 88 articles were eligible after duplicates were removed. After identifying the title and abstract, the number of studies included in the screening phase was 46, but only 39 were assessed for eligibility, while 7 were excluded as the articles were not full-text articles. Of the 39 articles assessed, 29 were not relevant to the topic under review and did not meet the inclusion and exclusion criteria. Therefore, only 10 articles were retained (Figure 1).

2.5 Data extraction

The review was achieved with the data separately extracted and summarized by HP and SP. The objectives of the study, the methodology, the results, and the significance of the topic under review were extracted using a table. The extraction tables were then consulted to KB and CM. The final extraction table can be seen in Table 1 (See appendix 1).

2.6 Quality appraisal

The 10-selected articles were assessed by two experts (KB and CM) for their quality in order to identify their strengths, weaknesses, utility, and validity. In addition, The Joanna Briggs Institute (2011)'s critical appraisal tools were used to evaluate the articles' quality. Critical appraisal tools were used to identify the appropriateness of the study design to the critical review question and determine the relevance of the articles to the topic under review (Polit, 2017). Some minor flaws of the studies were found; however, these were not significant enough to affect the study findings. Furthermore, the rigorous process found that all the articles reviewed were from level 2 to level 6 of evidence. According to Polit (2017), a systematic review with meta-analysis is at the first level, and randomised controlled trial (RCT) methodology is considered to be at level 2, while non-randomised controlled trials (quasi-experiments) are level 3. Prospective/cohort studies are at level 4, followed by case-control and cross-sectional studies at level 5 and 6, respectively. Qualitative studies and expert opinion are at the bottom level of evidence. In this review, two studies were at level 2 (RCTs), one study was at level 3 (the quasi-experimental study), three studies were at level 4 (cohort studies), one was at level 5 (the case-control study), and three studies were at level 6 (the cross-sectional study). The quality appraisal and article's levels of evidence are presented in Table 2.

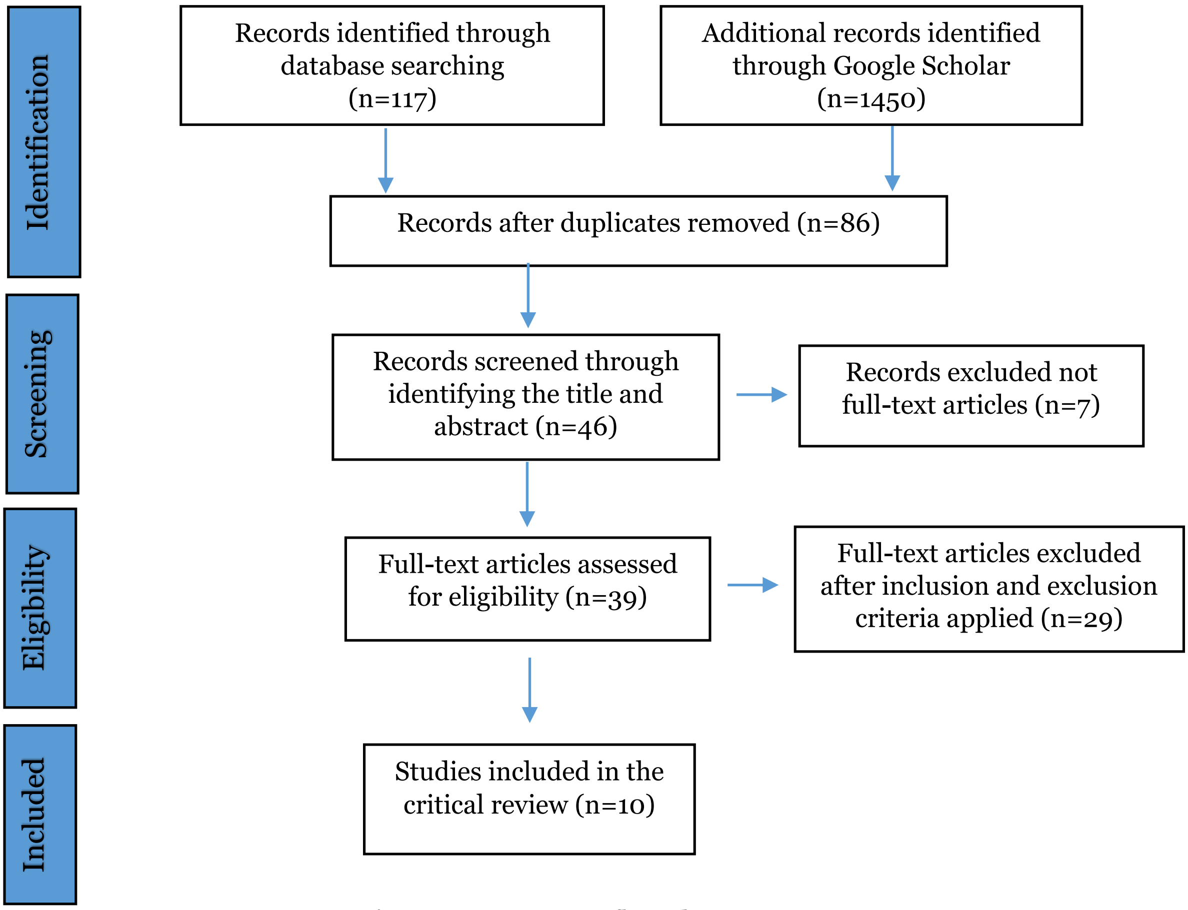

Figure 1. PRISMA flow diagram

2.7 Data analysis

This review could not perform a meta-analysis of the accuracy of the SALT and START triage systems due to heterogeneity in the methods and statistical values of the outcomes. Therefore, a thematic analysis was conducted (Nowell, 2017). The effectiveness and accuracy of the SALT and START triage systems were compared through four main themes: triage accuracy, over-triage, under-triage, and time to triage per individual victim. These findings are illustrated under the themed headings in Table 3.

Table 2. The level of evidence and quality of the articles

No of Article	Authors & Year	Methodology	Level of Evidence	Summary of Appraisal
1	Badiali et al. (2017)	Case-control	5	Good; This study was relevant to the topic, all criteria of the case-control study were met, and therefore, the findings were considered valid and reliable.
2	Cicero et al. (2016)	Cohort	6	Fair; This study was included in the topic under review even though the inclusion and exclusion criteria were not clearly mentioned. The authors

Table 2. Continued

No of Article	Authors & Year	Methodology	Level of Evidence	Summary of Appraisal
				described the participants' details, and also, the authors identified the confounding factors and applied a strategy to deal with these confounding factors. In addition, appropriate statistical analysis was used to investigate the findings.
3	Claudius et al. (2015)	Cross-sectional	6	Good; This study was included in the topics under review. Unlike some of the unclear explanations regarding the inclusion criteria of the sample, the authors clearly stated the confounding factors and ways of dealing with them. In addition, this study met the standards of a cross-sectional study.
4	Cone et al. (2011)	Quasi-experiment	3	Good; This study was relevant to the topic under review. All criteria for a quasi-experiment study were met. Therefore, this study was considered valid and reliable.
5	Hart et al. (2018)	Randomized control trial	2	Good; This study was relevant to the topic under review. Most of the RCT criteria had been met. Therefore, the findings of this study were considered to be valid and reliable.
6	Jones et al. (2014)	Randomized control trial	2	Good; This study was relevant to the topic under review and met the criteria of an RCT study.
7	Kahn et al. (2009)	A retrospective study	4	Fair; This study was relevant to the topic. This study met the criteria of a retrospective study, even though the authors did not clearly state how they dealt with the confounding factors. Overall, the results of the study were considered valid and reliable.
8	Lee et al. (2016)	Quasi-experiment	4	Good; This study was relevant to the topic under review. All criteria of a quasi-experimental study were met. Therefore, the study was recognised as valid and reliable.
9	Lerner et al. (2010)	Cross-sectional	4	Good; This study was relevant and considered to be valid and reliable. The authors dealt effectively with the confounding factors, which might limit any bias. In addition, this study met the criteria of a cross-sectional study.
10	Silvestri et al. (2017)	Randomized controlled trial	6	Fair; This study was considered relevant to the topic under review, regardless of some of the selection criteria of the RCT study not being clear. The findings of the study were considered valid due to meeting most of the criteria of a cross-sectional study.

3. Results

3.1 Characteristics of the study

Among the 10 articles reviewed, five studies investigated the accuracy of the START and jumpSTART systems, three explored the effectiveness of SALT, and two studies directly compared the accuracy of the SALT and the START/jumpSTART triage systems. In addition, of the ten articles reviewed, seven applied the SALT and START triage systems to adult populations, whereas three articles were applied in the paediatric population. Furthermore, eight of the ten studies were conducted through MCI victim simulations, whereas two analyzed MCI victims' medical records.

3.2 Effectiveness of the SALT and START triage systems

The effectiveness of the SALT and START triage systems were compared through four main themes: triage accuracy, over-triage, under-triage, and time to triage per individual victim (Table 3). The explanation of each theme is described below.

Table 3. The thematic analysis of systematic review

Main theme	Number of studies that support theme/subtheme
Accuracy of SALT and START triage systems	n=9 1,2,3,4,6,7,8,9,10 Badiali et al. (2017); Cicero et al. (2016); Claudius et al. (2015); Cone et al. (2011); Jones et al. (2014); Kahn et al. (2009); Lee et al. (2016); Lerner et al. (2010); Silvestri et al. (2017)
Over-triage of SALT and START triage systems	n=7 1,4,6,7,8,9,10 Badiali et al. (2017); Cone et al. (2011); Jones et al. (2014); Kahn et al. (2009); Lee et al. (2016); Lerner et al. (2010); (Silvestri et al., 2017)
Under-triage of SALT and START triage systems	n=7 1,4,6,7,8,9,10 Badiali et al. (2017); Cone et al. (2011); Jones et al. (2014); Kahn et al. (2009); Lee et al. (2016); Lerner et al. (2010); Silvestri et al. (2017)
Time to apply START and SALT triage systems	n=8 1,3,4,5,6,7,8,9 Badiali et al. (2017); Claudius et al, (2015); Cone et al. (2011); Jones et al. (2014); Kahn et al. (2009); Lee et al. (2016); Lerner et al. (2010); Hart et al. (2018)

3.2.1 Theme 1: The accuracy of SALT and START triage systems

According to the studies, the accuracy of the START/jumpSTART system ranged from 44% to 94.2%. The 44% accuracy was reported when the START triage system was applied to crash train victims' medical records in 2003 in the USA (Kahn et al., 2009), whereas the 94.2% accuracy was identified when this triage system was used in a review of the medical records of the Emergo Train System (ETS) victims in Italy (Badiali et al., 2017). In addition, in a simulated paediatric MCI scenario, medical students achieved a jumpSTART accuracy of 85.7% (Claudius et al., 2015). Moreover, Cicero et al. (2016), in their simulated MCIs study among medical students, found that jumpSTART was more accurate than other disaster and MCI triage systems. On the other hand, three mass casualty simulation-based studies identified the range of accuracy of the SALT triage system to be between 70% and 83%. The 70% triage accuracy for paramedic students using SALT was identified during a bus crash simulation (Cone et al., 2011), while a 79% accuracy was reported during a simulation of a four-car motor vehicle collision (Lee et al., 2016). Moreover, a previous study that involved trainees involved in a disaster course found that the accuracy of the SALT system was 83% during MCI simulations (Lerner et al., 2010).

Two articles were found that compared the accuracy of the SALT and START/jumpSTART triage systems in one MCI simulation-based study. Jones et al. (2014) found that paramedics achieved an accuracy of 66% for both the SALT and the START triage systems during a paediatric MCI simulation, while Silvestri et al. (2017) found that the SALT triage system was more accurate among medical response teams and fire rescue teams during MCIs and disaster simulations.

3.2.2 Theme 2: Over-triage of SALT and START triage systems

Over-triage refers to the over-estimation of the acuity of patients, indicating that the participants were given a higher level of patient acuity. The over-triage error of the START triage system was found in seven studies, ranging from 2% to 53%. The lowest over-triage error (2%) for first responders was reported during a simulated study (Silvestri et al., 2017), whereas the highest over-triage error (53%) was found in applying the START system to MCI train crash victims' medical records (Kahn et al., 2009). In contrast, the rate of over-triage error of the SALT system was from 2% to 22%, with the lowest rate (2%) being identified in the Silvestri et al. (2017) simulation among first responders. The highest rate (22%) was found on the MCI simulation among paramedics by Jones et al. (2014).

The comparison of over-triage error between the START and SALT models was found in two studies. Silvestri et al. (2017) reported an over-triage error of 2% for both triage systems, whereas Jones et al. (2014) found over-triage errors of 22% and 23% for the SALT and START triage systems, respectively.

3.2.3 Theme 3: Under-triage of SALT and START triage systems

Under-triage means that there has been an underestimation of the acuity of injured victims or patients (Dolan & Holt, 2013). According to the ten studies reviewed, the under-triage error of the START triage system ranged from 2.73% to 20%. Two studies based on MCI victims' medical records reported an under-triage error of 2% (Badiali et al., 2017; Kahn et al., 2009), whereas two other MCI simulation-based studies revealed an under-triage error of 11% and 20% (Jones et al., 2014; Silvestri et al., 2017). Conversely, five studies found the under-triage error of SALT to be between 7.6% and 23.2%. Of these, four studies revealed under-triage errors of 7.6% (Lee et al., 2016), 9% (Silvestri et al., 2017), 10% (Jones et al., 2014), and 11% (Lerner et al., 2010) during mass casualty simulations. However, one study reported an under-triage error of 23.2% for paramedic students during a bus crash simulation (Cone et al., 2011).

When comparing the under-triage error of the START and SALT systems, one simulation-based study found that the START triage system had a higher rate of under-triage error than did SALT. According to Jones et al. (2014), the under-triage error of jumpSTART was 11.2% compared to 10% for the SALT triage system. Moreover, Silvestri et al. (2017) found that there was a significantly different rate of under-triage error between the START and SALT triage systems of 20% and 9%, respectively (Cone et al., 2011).

3.2.4 Theme 4: Time to apply START and SALT triage systems per individual victim

Time to triage refers to the mean time needed to triage one individual patient. There were eight studies investigating the time to apply the START and SALT triage systems to an individual patient. According to Claudius et al. (2015), the mean time to apply jumpSTART to paediatric scenario victims was 70.4 seconds. Similarly, Hart et al. (2018) found that the mean time to apply START in simulated patients was 72.18 seconds per patient. In addition, some studies also revealed that applying START was faster than SALT (Badiali et al., 2017). When comparing the START and SALT models, it was found that the time needed for applying the START model was 8 seconds faster than SALT (Jones et al., 2014).

4. Discussion

The purpose of this study was to compare the effectiveness and accuracy of the SALT and START triage systems in disaster and MCI settings. The result showed that the highest level of accuracy of the START system was recorded at 94.2% when this model was applied to the medical record data of MCI train victims in Italy. Whereas in another MCI victim medical record analysis from the USA, it was found that the accuracy of the START system was only 44% (Badiali et al., 2017; Cicero et al., 2016; Cone et al., 2011; Jones et al., 2014; Kahn et al., 2009; Lee et al., 2016; Lerner et al., 2010; Silvestri et al., 2017). This indicates that the START triage system is inconsistent in terms of accuracy. Accuracy means correctness and precision. In terms of triage, accuracy refers to the precise estimation of the acuity of injured patients as well as the correct allocation of time for patients to receive the medical intervention (Dolan & Holt, 2013). In contrast, the SALT model appears to be more consistent than the START triage system. This can be seen through the SALT accuracy percentages of between 70% and 84%. In addition, when comparing the accuracy of the START and SALT triage systems in a simulation study, it was found that the SALT was more accurate than the START triage system.

The findings of this critical review reveal that even though the START triage system was simpler and faster than the SALT triage system, the latter was more accurate and consistent. These findings concur with those of a previous study conducted by Fink et al. (2018), which revealed that the SALT triage system was preferable to the START triage system among 21st-century healthcare students. This is because the SALT triage system was considered to be more comprehensive, fit for all ages, and placed emphasis on saving lives (Fink et al., 2018). Nevertheless, the magnitude of these accuracy differences was relatively small and was only found in a very limited number of studies. Only one study clearly stated that the SALT triage system was significantly more accurate and had a lower rate of under-triage (Silvestri et al., 2017). This indicates that SALT may not be significantly different from the START triage system in terms of accuracy. These findings also support a previous study conducted by Bazyar et al. (2019), which revealed that among 23 triage systems reviewed, no triage system was superior to the others. In addition, the lack of accuracy of the SALT and START triage systems might have been caused by the study setting. According to Jones et al. (2014), the use of a simulation scenario can result in inappropriate triage classifying. Jones et al. (2014) found that most of the respondents faced technical problems during the simulation, such as the blue light around the scene-setting, which could have influenced the interpretation of the patient's condition, with another issue being that some of the participants supposed to have a skin cyanosis condition which then affected the level of triage.

Similarly, the effectiveness of the START and SALT triage systems in relation to under-triage also showed a level of inconsistency. The START under-triage error ranged from 2.73% to 20%, while SALT was between 7.6% and 23.2%. However, in two specific studies which compared the START and SALT triage systems, one simulation study found that the under-triage error of START was greater than for the SALT triage system (Badiali et al., 2017; Kahn et al., 2009). Under-triage indicates that many patients or victims will not receive an intervention appropriately. According to the American College of Surgeons Committee on Trauma (ACS-COT), for general trauma, the rate of under-triage should be no more than 5%. Under-triage is recognised as a negative outcome for trauma victims of disasters and MCIs (Jeppesen, 2020). When comparing the under-triage error of the START and SALT systems, two studies found that the START triage system had a higher rate of under-triage error than did SALT (Jones et al., 2014; Silvestri et al. 2017).

Moreover, the effectiveness as indicated through over-triage found a wide range of errors. The over-triage error of the START triage system was reported as 2% to 53%, while the SALT was between 2% and 22% (Silvestri et al., 2017). There are no studies that revealed the over-triage error of one triage system as being greater than the other. However, one particular study found an over-triage error of 53% when START was applied to train crash victims' medical records in the USA (Kahn et al., 2009). Over-triage would have an impact on inefficient responses and would represent a higher risk to the entire emergency medical system (Dolan & Holt, 2013). This is because over-triage can add to the waiting time for emergency department triage, delay treatment for other patients, and trigger ineffective use of resources (Dolan & Holt, 2013). In the context of disaster, having more resources is vital due to the nature of MCIs and disasters, where resources are not balanced with demand (due to the high number of patients).

A confounding factor that might have contributed to the ineffectiveness of triage was related to the clarity of the SALT and START criteria. According to Lerner et al. (2010), the typical error of triage in SALT was in identifying the level of "minimal" criterion as the level of "delayed". The SALT triage system used the category "minor injury only" as the criterion for "delayed", which in turn, could have influenced the patient to use "delayed" instead of the "minimal" criterion. Therefore, this might have contributed to a number of under-triage errors. Similarly, the most frequent error of the START system was when identifying the "minimal" as the "delayed" category (Lee et al., 2016). In the START triage system, the criteria of "minimal" depended on patient mobility. If the patient could walk, they would be identified as "minimal" (US Department of Health and Human Services, 2019b). However, according to Lerner et al. (2015), the criterion of "minimal" is considered when patients do not require laboratory testing or have an uncomplicated fracture or a simple wound repair, whereas in (Kahn et al., 2009) study, the START triage system criterion placed a patient who is able to ambulate as "delayed" rather than "minimal". This lack of consistency creates the potential for both under- and over-triage. The study identifying factors which might have contributed to the ineffectiveness and inaccuracy of triage was related to the clarity of the SALT and START criteria are needed in the future.

The effectiveness of the triage system was related to the time needed to triage one individual patient. The mean time to apply jumpSTART to paediatric scenario victims was 70.4 seconds (Claudius et al., 2015). Another study similarly found that the mean time to apply START in simulated patients was 72.18 seconds (Hart et al., 2018). On the other hand, Cone et al. (2011) found that the SALT triage system needs 50.5 seconds to be applied in simulated patients, and Lee et al. (2016) reported that it requires 40 to 52 seconds to apply SALT triage system. Based on those studies, the circumstances and scene size of MCIs in each study were different. Therefore, it cannot be assumed that SALT triage system was faster than START. However, one particular study which directly compared the mean time between START and SALT found that START triage system was 8 seconds faster that SALT which accounted for 26 seconds and 34 seconds, respectively (Jones et al., 2014). Hence, it is argued that START is faster than SALT because START has been developed for resource-limited field triage settings. Prioritizing patients in the immediate category of assisting patients who are more likely to survive than those in the high-risk category has made START faster than other triage systems (Silvestri et al., 2017; Lin et al., 2020). The delay in triage time could be an impact on the patient's outcomes, particularly in critically-ill patients, because it triggers delayed treatments (Claudius et al., 2015). In the MCI's context, the delay in triage time could be neglected by the other victims, which result in less victims being rescued. In the case of MCIs, the red category patients need to be transported maximally one hour earlier than other categories (Kahn et al., 2009). Hence, minimizing delay in applying triage is essential.

5. Implications and limitations

It is acknowledged that it was difficult to draw a conclusion due to design limitations in many studies in this review. The issues of technical problems during study interventions as well as inappropriate study simulation may lead to an inaccurate conclusion. In addition, the heterogeneity of study populations leads to difficulty comparing results across the study, which influences the conclusion. Nevertheless, the findings of the review could be used to inform the Indonesian Ministry for disaster preparedness about the most effective triage system to use during disasters and MCIs. The SALT triage system appears to be slightly more accurate and consistent than START; however, the impact on patient outcomes is still questionable.

6. Conclusion

This systematic review has revealed the effectiveness of the START and SALT triage systems in relation to the level of accuracy, under- and over-triage, and the time needed to apply these triage systems in the MCI and disaster contexts. The evidence indicated that even though the START triage system is simpler and faster than SALT, there is some inconsistency in the level of accuracy of the START triage system in classifying victim acuity. Conversely, the SALT triage system appears to be slightly more accurate and consistent and has a lower rate of under- and over-triage error than START. Therefore, it appears that neither the SALT nor the START triage system is superior to the other. Moreover, regardless of triage error, either the START or the SALT triage system can be equally effective for triaging victims of disasters and MCIs, and therefore, can be applied in the MCI and disaster contexts. However, a study that identifies factors that might have contributed to the inaccuracy of the START and the SALT triage system, as well as inaccuracy itself, requires further research to establish the most appropriate disaster and MCI triage system for the Indonesian context.

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Author contribution

HP conceptualized, designed, prepared the initial draft and framework, wrote the paper, and interpreted the data. KB, CM, and SP conceptualized and interpreted the data. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

No conflict of interest has been declared by the authors.

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Appendix 1.

Table 1. Extraction table of the included studies

No	Authors (year)	Objectives	Methodology	Results	Significant to the topic under review
1	Badiali et al. (2017)	To determine the accuracy of the START triage system for improving patient outcomes.	Design: Case-Control Sample: 400 non-medical ambulance crew Setting: The participants were assigned to two groups. The first group received training in the START triage system, whereas the other group did not get training. Each group was assigned to examine triage code to 6,000 patients medical record Emergo train system Italia.	1. The START triage group was faster than the non-START group in completing the evaluation (15 and 30 minutes, respectively). 2. The accuracy of the START group was 94.2% compared to 59.83% of the non-START triage group. This difference was statically significant. 3. The START group over-triage was 13.6% as opposed to 26.5% in the non-START group. 4. Under-triage accounted for 2.73% for the START group and 3.08% for the non-START group. 5. START was found to be effective for improving patient outcomes.	This research is related to the topic under review (the START triage system) and contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage) In addition, this research revealed that the use of the START algorithm is more effective than the non-START algorithm for improving patient outcomes during MCIs.
2	Cicero et al. (2016)	To compare the accuracy of the Smart triage system and the jumpSTART system, Clinical Decision Making (CDM), and no algorithm in classifying patient's level of acuity.	Design: Cohort Sample: 273 paramedics who enrolled in a Paediatric Disaster Triage (PDT) curriculum Setting: Participants were divided into cohorts by triage strategy to apply disaster triage to 10 simulated disaster victims.	1. The accuracy of jumpSTART was statistically greater than SMART ($P<0.001$; OR [odds ratio]: 2.03) and CDM ($P=0.02$; OR: 1.76). 2. JumpSTART outperformed Smart for RED and yellow patients, while CDM for BLACK patients.	This research revealed that the accuracy of jumpSTART was greater than other triage systems such as SMART and CDM, particularly in classifying "immediate/red" and "delayed/yellow" patient categories. This study contributes to: - Theme 1 (accuracy of START/ jumpSTART)
3	Claudius et al. (2015)	To evaluate the accuracy of jumpSTART in mass casualty incidents, particularly for paediatric patients	Design: Cross-sectional Sample: 33 students Setting: All participants applied jumpSTART to 363 scenarios of paediatric MCI victims (actor and computer simulation)	1. The overall accuracy of jumpSTART was 85.7% 2. The mean time to assign jumpSTART on one paediatric MCI victim was 70.4 seconds. Notably, this time depended on the level of patient acuity, meaning that the time would decrease as the triage level decreased, or the mean time would increase as the triage level increased.	This study revealed the accuracy of jumpSTART as well as the mean time to apply this triage in paediatric MCI victims. This study contributes to: - Theme 1 (accuracy) - Theme 4 (time)

Table 1. Continued

No	Authors (year)	Objectives	Methodology	Results	Significant to the topic under review
4	Cone et al. (2011)	To compare the effectiveness of the SALT and SMART triage systems in classifying the level of MCI victims acuity	Design: Non-random control trial (quasi-experimental) Sample: 22 paramedic students Setting: Participants have been trained in the SALT triage system and applied it to 25 victims of a bus crash in a virtual reality simulation. After three months, the participants were also retrained in the SMART triage system and applied it to the same victims (25 victims of the bus crash).	1. The accuracy of SALT was 70% compared to 93% for SMART (p=0.0001). 2. Over-triage was 6.8% for SALT and 1.8% for SMART (p=0.0015). 3. Under-triage was 23% for SALT and 5.1% for SMART. 4. The SMART triage time to triage the scene was faster than SALT at 11 minutes and 59 seconds, and 21 minutes and 3 seconds, respectively (p=0.0001).	This research was related to the topic under review (SALT), which revealed that the accuracy and time of the SALT triage system were statistically worse than the other triage algorithm (SMART). This study contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage) - Theme 4 (time)
5	Hart et al. (2018)	To compare the speed of response between the START triage system and an intuitive triage system	Design: Randomized controlled trial Sample and setting: Two groups of participants were assigned to apply the START triage algorithm and an intuitive triage on simulated MCI victims	1. The intuitive triage was faster to identify victims level of triage compared to START (72.18 seconds vs. 106.57 seconds), particularly in identifying patients with “red/immediate” and “yellow/delay” criteria. 2. No statistical difference in the incidence of under- and over-triage between START triage and intuitive triage.	This study was relevant to the topic under review where the speed of response of the START triage was recorded. The research findings revealed that there was no statistical significance between START triage and intuitive triage in terms of accuracy. However, they varied significantly in terms of speed of response, with intuitive triage being faster than START triage. This study contributes to: - Theme 1 (accuracy) - Theme 4 (time)
6	Jones et al. (2014)	To compare the effectiveness of the jumpSTART and the SALT triage systems in the pediatric population during a mass casualty incident	Design: Randomized controlled trial (RCT) Sample: 43 paramedics Setting: All participants were randomly divided into either the SALT or the jumpSTART study group. A fifteen-minute lecture on the SALT and jumpSTART triage systems was given. All participants were assigned to apply triage to 10 paediatric simulated patients based on which group they were in.	1. The accuracy of SALT and jumpSTART was 66% each. 2. Over-triage was 22% for SALT compared to 23% for jumpSTART. 3. Under-triage was 10% for SALT compared to 11.2% for jumpSTART. 4. jumpSTART was statistically faster than SALT (8 seconds faster).	This study was relevant to the topic under review. The study findings revealed that there were no differences in accuracy between the SALT and START triage systems. However, jumpSTART was statistically faster than SALT when applied to a paediatric population. This study contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage) - Theme 4 (time)

Table 1. Continued

No	Authors (year)	Objectives	Methodology	Results	Significant to the topic under review
7	Kahn et al. (2009)	The objective of this study is to investigate the sensitivity and specificity of the START triage system	Design: A retrospective study Sample: 148 train crash victims from 2013 Setting: The authors applied the START triage system to the medical records of 148 victims a train crash disaster in 2003.	1. The accuracy of the START triage system was 44.5%. 2. Over-triage was 53.3%. 3. Under-triage was 2%. 4. The transportation of a patient in the red/immediate category was 1 hour earlier than in the other categories. 5. This study concluded that SALT has poor sensitivity when applied to a database of MCI victims.	This study was related to the topic under review. According to the study findings, the accuracy of the START triage system when applied to an MCI victim database was low, while over-triage appeared to be high. However, the START triage system had high sensitivity in transporting patients in the "red/immediate" category. This study contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage) - Theme 4 (time)
8	Lee et al. (2016)	To investigate the accuracy of the SALT triage system on simulated MCI patients	Design: Quasi-experimental Sample: 67 students Setting: 67 paramedic and fire science participants were assigned to apply SALT to a four-car motor vehicle collision. A 30-minute dictate period was given prior to the study.	1. The accuracy of SALT was 79.9% for paramedics and 72% for fire science students. No significant difference. 2. Over-triage was 10.2% for paramedic students compared to 15.2% for fire science students. 3. Under-triage was 7.6% for paramedics and 8.7% for fire science students. 4. The paramedics needed 52.6 seconds to do triage compared to 40.5 second by the fire science students. 5. The study concluded that paramedics seemed to perform more accurately than fire science students, even though this was not statistically significant.	This study was related to the topic under review in terms of measuring the accuracy of the SALT triage system and the speed of triage. This study contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage) - Theme 4 (time)
9	Lerner et al. (2010)	To assess the accuracy of the SALT triage system when applied to simulated MCI victims	Design: Cross-sectional Sample: 73 trainees of a disaster course Setting: Participants were assigned to apply the SALT triage system for 217 simulated victims. A 30-minute lecture was given prior to the study.	1. Accuracy of the first triage was 81% to 83% afterwards. 2. 6-8% were over-triaged. 3. 10-11% were under-triaged. 4. The speed of triage for every patient was 28 seconds. 5. The authors concluded that SALT was accurate in classifying patients in MCI cases.	This study was relevant to the topic under review. This study revealed that SALT had high accuracy in classifying MCI patients. This study contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage) - Theme 4 (time)

Table 1. Continued

No	Authors (year)	Objectives	Methodology	Results	Significant to the topic under review
10	Silvestri et al. (2017)	To compare the accuracy of the SALT and START triage systems in classifying patient levels in a mass casualty incident	Design: Experimental random controlled trial Sample and setting: Multi-agency regional Fire and Rescue Response and Florida State Medical Response Team assigned SALT and START to 82 simulated MCI victims	1. Overall, the SALT triage system was a more accurate triage method than START at classifying patients, specifically in the delayed and immediate categories. 2. SALT had a significantly lower under-triage rate (9 per cent [95%CI 2-15]) than both START (20 per cent [95%CI 11-28]) and field triage (37 per cent [95%CI 24-52]). 3. There were no significant differences in over-triage rates.	This study was relevant to the topic under review; the study results suggested that the SALT triage system was more accurate than START, which had significantly lower under-triage. This study contributes to: - Theme 1 (accuracy) - Theme 2 (under-triage) - Theme 3 (over-triage)