A Modified Simple Triage and Rapid Treatment Algorithm from the New York City (USA) Fire Department

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Abbreviations:
EMS: Emergency Medical Services
EMT: emergency medical technician
FDNY: Fire Department of the City of New York
MCI: mass-casualty incident
START: Simple Triage and Rapid Treatment

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Abstract

Introduction: The objective of this study was to determine if modification of the Simple Triage and Rapid Treatment (START) system by the addition of an Orange category, intermediate between the most critically injured (Red) and the non-critical, non-ambulatory injured (Yellow), would reduce over- and under-triage rates in a simulated mass-casualty incident (MCI) exercise.

Methods: A computer-simulation exercise of identical presentations of an MCI scenario involving a 2-train collision, with 28 case scenarios, was provided for triaging to two groups: the Fire Department of the City of New York (FDNY; n = 1,347) using modified START, and the Emergency Medical Services (EMS) providers from the Eagles 2012 EMS conference (Lafayette, Louisiana USA; n = 110) using unmodified START. Percent correct by triage category was calculated for each group. Performance was then compared between the two EMS groups on the five cases where Orange was the correct answer under the modified START system.

Results: Overall, FDNY-EMS providers correctly triaged 91.2% of cases using FDNY-START whereas non-FDNY-Eagles providers correctly triaged 87.1% of cases using unmodified START. In analysis of the five Orange cases (chest pain or dyspnea without obvious trauma), FDNY-EMS performed significantly better using FDNY-START, correctly triaging 86.3% of cases (over-triage 1.5%; under-triage 12.2%), whereas the non-FDNY-Eagles group using unmodified START correctly triaged 81.5% of cases (over-triage 17.3%; under-triage 1.3%), a difference of 4.9% (95% CI, 1.5-8.2).

Conclusions: The FDNY-START system may allow providers to prioritize casualties using an intermediate category (Orange) more properly aligned to meet patient needs, and as such, may reduce the rates of over-triage compared with START. The FDNY-START system decreases the variability in patient sorting while maintaining high field utility without needing computer assistance or extensive retraining. Comparison of triage algorithms at actual MCIs is needed; however, initial feedback is promising, suggesting that FDNY-START can improve triage with minimal additional training and cost.

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Introduction

The term "triage" is derived from the French word meaning "to sort." The concept of medical triage dates back to the battlefield setting during the Napoleonic Wars (1803-1815).[1] Under usual circumstances, Emergency Medical Service (EMS) personnel are required to ensure scene safety, and, as best able, to rapidly triage patients according to apparent need and priority. In a mass-casualty incident (MCI), proper triage becomes especially important to accommodate a surge of patients with potentially life-threatening injuries and medical conditions. Mass-casualty triage differs from standard field triage because in the mass-casualty setting, patient needs often exceed available resources.[2,3]

Therefore, EMS personnel must shift their usual focus from the individual patient to instead ensure that the greatest good is provided to the greatest number of patients. Depending on the disaster or incident, and the associated mechanisms of injury, an increased number of casualties will burden various health care systems. Innovative MCI triage strategies are necessary to facilitate informed decisions about the allocation of limited resources across all systems.

The most widely used MCI triage algorithm in the US is the Simple Triage and Rapid Treatment (START) system, developed in 1983 in Newport Beach (California USA),[4] and later modified to substitute radial pulse in place of capillary refill.[5] The algorithm was designed to be taught easily and to rapidly sort patients according to their anticipated survivability and the relative urgency of need for medical intervention. The standard START system categorizes patients into one of four priorities: Priority One (Red Tags) – non-ambulatory patients with immediate life-threatening injuries or illness; Priority Two (Yellow Tags) – non-ambulatory patients, but without immediately life-threatening injuries or illness; Priority Three (Green Tags) – so called "walking wounded," presumed to be of lower acuity by virtue of being ambulatory with normal vital sign parameters; and Priority Four (Black Tags) – dead, or critically injured and unlikely to survive despite treatment.

In contrast to the battlefield setting, civilian victims, especially in urban settings, are more heterogeneous in their pre-crisis health status, and thus, are more likely to experience sequelae of medical comorbidities (eg, ongoing chest pain or dyspnea) as a result of the MCI. These non-traumatic injuries/illnesses are not accounted for easily with START[4,5] or other traditional trauma-triage algorithms.[6-12] For example, at an MCI, a patient with coronary artery disease or asthma may develop chest pain or dyspnea from stress, exertion, and/or irritant exposures. Typically, their vital signs do not meet Red criteria, and thus, they would be triaged as low priority (Green if ambulatory or Yellow if non-ambulatory). While these injuries/illnesses are not immediately life-threatening, they may become critical if not prioritized, despite, in certain situations, being more salvageable than Priority One (Red Tag) injuries/illnesses.

The Fire Department of the City of New York (FDNY; New York USA) Bureau of EMS oversees the largest EMS system in the country, with approximately 3,500 calls daily, totaling 1.3 million calls in 2013. The FDNY defines an MCI as any incident with five or more patients and annually responds to thousands of such incidents. Based on the knowledge from MCIs that occurred in New York City,[13,14] and in consensus with emergency medicine, critical care, and trauma specialists, FDNY developed a modified START system that was implemented in 2012.[15] The FDNY-START system adds an Orange category between the existing Red and Yellow categories to identify patients with the potential for evolution to critical illness, and thereby, to more appropriately prioritize their treatment and transport (Figure 1). Further, because Orange patients are typically suffering from chronic medical issues rather than traumatic injuries, this could allow EMS to preferentially transport Orange patients to hospitals without trauma center designations when the available resources are similar, or better suited to manage these underlying conditions (eg, a cardiac catheterization center for acute myocardial infarction with ST-segment elevations and a hyperbaric chamber for carbon monoxide intoxication). The Orange category was defined to allow for ease in implementation without the need for complex prioritization matrices that require computer assistance and extensive retraining.[16,17] Simply, an Orange Tag (Priority Two) designation would be any patient, even if ambulatory, with chest pain, dyspnea, or head trauma, regardless of mechanism (ie, asthma/chronic obstructive pulmonary disease, angina, toxic inhalation injury, or trauma), who fails to meet Red Tag (Priority One) criteria.

This pilot study was designed to test the hypothesis that introduction of an Orange Tag category within FDNY-START would reduce both over- and under-triage rates compared with these rates in a similar group of EMS experts using the unmodified START for the same simulated case series.

Methods

A computer-simulation exercise of identical presentations of an MCI scenario involving a 2-train collision beneath NYC's Penn Station (New York, USA) was provided to two groups of EMS providers (EMTs and paramedics): Group 1 from FDNY and Group 2 from the Eagles (US Metropolitan Municipalities EMS Medical Directors Consortium; USA) 2012 EMS State of the Sciences conference (Lafayette, Louisiana USA). Thirty cases were presented, each included a brief description of the patient's age, gender, and injuries, along with all of the necessary descriptors required to triage patients appropriately using the algorithm being implemented (ie, the FDNY-START for the first group and the unmodified START for the second). After each case was presented, providers were allotted 10 seconds to document their triage decision. After completing the exercise, providers' triage decisions were tabulated and compared to the predetermined correct triage categorizations (specific to the triage algorithm used).

Before the trial, the 30 case scenarios were vetted independently by two EMS physicians experienced in MCI field triage to determine the correct triage category assignment. There was 100% agreement between the two physicians in category assignment. During the trial, however, FDNY test-takers questioned two scenarios (cases 10 and 13; Appendix, available online only): there was confusion as to whether they had been taught that vascular or penetrating wounds were Orange or Yellow when vital signs were stable. This prompted a review of all 30 case scenarios by four EMS physicians to determine if there were ambiguities in either the wording of these cases or in the training materials. There was unanimous agreement that only these two questions (numbers 10 and 13; Appendix, available online only) were testing an issue for which the training materials were extremely unclear, and therefore, these two questions were removed from analyses.

Upon completion of the computer simulation, the authors calculated percent correct by triage category for each group. Incorrect answers were used to calculate over- and under-triage rates.

To account for underlying differences in the accuracy of triage designations between the groups, the analyses were limited to subgroups within each larger group whose overall triage accuracy scores were within the same range (a total of 17-22 cases triaged correctly) for the 23 case scenarios where an Orange Tag was not the correct answer. Responses between the two subgroups on the five case scenarios where Orange was the best answer for the FDNY-START subgroup were then compared. Additional characteristics (ie, years of EMS work and level of training) were analyzed only within the FDNY-EMS subgroup, as this information was not available for the non-FDNY-Eagles subgroup. All analyses were performed using SAS version 9.3 (SAS Institute; Cary, North Carolina USA). This study was

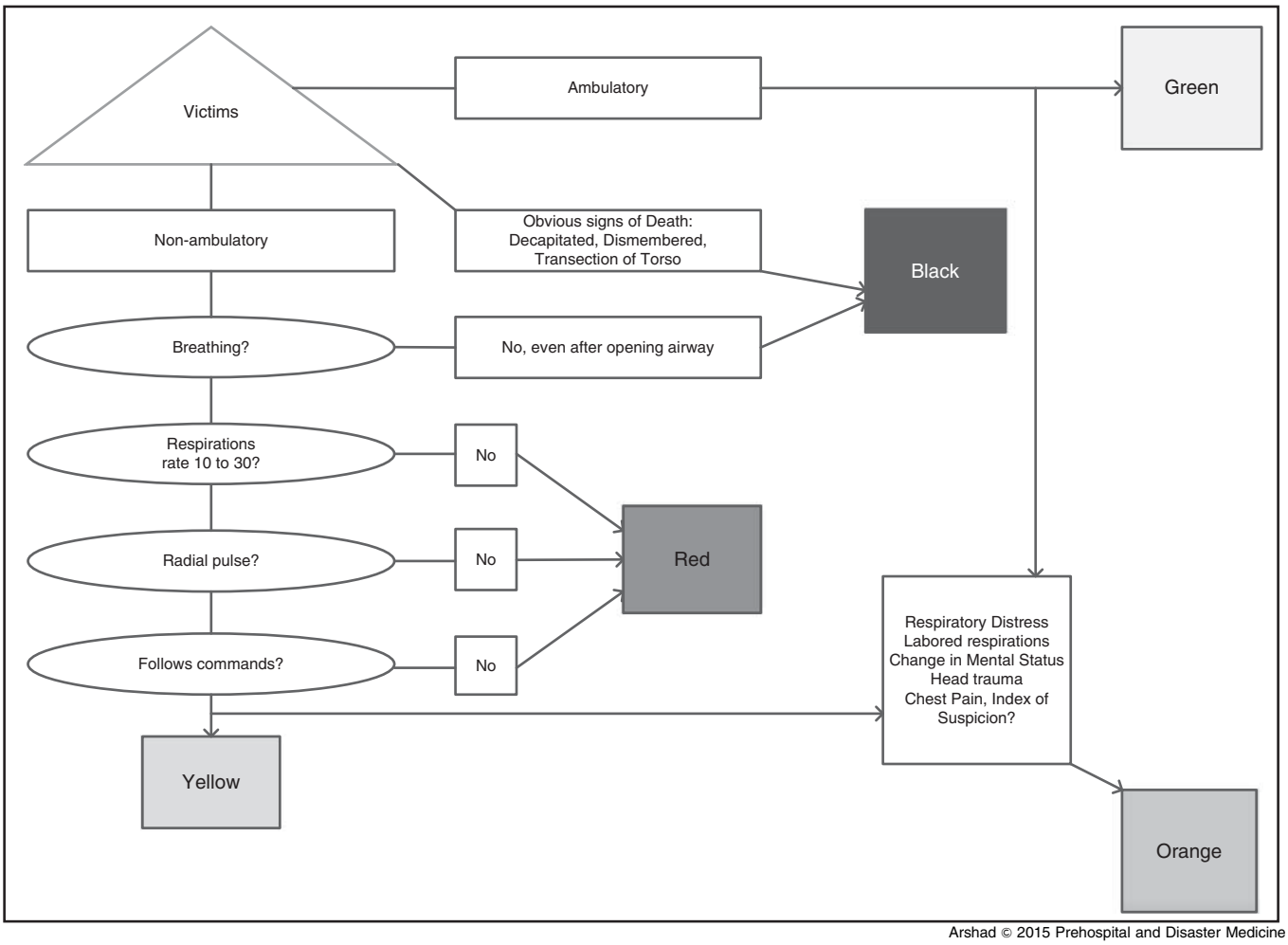

Figure 1. FDNY-START Triage. The standard START system categorizes patients into one of four priorities: Priority One (Red Tags) – non-ambulatory patients with immediate life-threatening injuries or illness; Priority Two (Yellow Tags) – non-ambulatory patients, but without immediately life-threatening injuries or illness; Priority Three (Green Tags) – "walking wounded," presumed lower acuity by being ambulatory with normal vital sign parameters; and Priority Four (Black Tags) – deceased. The FDNY-START adds an Orange category between Red and Yellow to identify any patient with chest pain, dyspnea, or head trauma, regardless of mechanism (ie, asthma/chronic obstructive pulmonary disease, angina, toxic inhalation injury, or trauma), who fails to meet Red Tag criteria. In a disaster with large numbers of patients, this added specificity is critically important to avoid up-triage to Red with an inappropriate use of relatively scarce EMS resources, as well as under-triage to Yellow or Green with an inappropriate lower level of monitoring and treatment.
Abbreviations: EMS, Emergency Medical Services; FDNY, Fire Department of the city of New York; START, Simple Triage and Rapid Treatment.

approved by the Institutional Review Board for Montefiore Medical Center, Bronx, New York (USA).

Results

The similar subgroups of FDNY-EMS and non-FDNY-Eagles comprised 1,347 and 110 EMS providers, respectively. The comparability of these groups was assessed in triage accuracy, before including the new Orange category for the FDNY-START, by examining their performance in assessing the 23 case scenarios where Orange was not the correct answer. The authors found that FDNY-EMS correctly triaged 92.2% of these scenarios and over-/under-triaged 4.4% and 3.4%, respectively. Non-FDNY-Eagles correctly triaged 88.3% of these scenarios and over-/under-triaged 2.1% and 9.6%, respectively (Table 1).

The authors then examined performance on the five case scenarios where Orange was the best answer for FDNY-EMS. In the non-FDNY-Eagles group, the authors accepted alternate responses for the five case scenarios, as Orange was not an available response. For the Orange Tag cases (chest pain or dyspnea without obvious trauma), FDNY-EMS performed significantly better using FDNY-START than did the non-FDNY-Eagles providers using unmodified START ($P = .0016$). The FDNY-EMS group correctly triaged 86.3% of cases (over-triage 1.5%; under-triage 12.2%) whereas the non-FDNY-Eagles group correctly triaged 81.5% of cases (over-triage 17.3%; under-triage 1.3%; Table 1).

Overall, examining all 28 case scenarios, FDNY-EMS providers correctly triaged 91.2% of cases using FDNY-START

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	Correctly Triaged		Over Triaged		Under Triaged	
23 Questions Where Orange Was Not the Correct Answer:						
Overall Non-FDNY	2,233	88.3%	54	2.1%	243	9.6%
Overall FDNY-EMS	28,578	92.2%	1,366	4.4%	1,037	3.4%
5 Questions Where Orange Was the Correct Answer for FDNY-EMS						
Overall Non-FDNY-Eagles	448	81.5%	95	17.3%	7	1.3%
Overall FDNY-EMS	5,813	86.3%	101	1.5%	821	12.2%

Table 1. Triage Accuracy Using START and FDNY-START
Abbreviations: EMS, Emergency Medical Services; FDNY, Fire Department of the city of New York; START, Simple Triage and Rapid Treatment.

FDNY-EMS (FDNY-START)	Correctly Triaged		Over Triaged		Under Triaged	
Overall	34,391	91.2%	1,467	3.9%	1,858	4.9%
Black	1,317	97.7%	N/A	N/A	30	2.2%
Red	5,852	86.9%	3	0.04%	880	13.1%
Orange	5,813	86.3%	101	1.5%	821	12.2%
Yellow	8,944	94.9%	358	3.8%	127	1.4%
Green	12,465	92.5%	1,005	7.5%	N/A	N/A
Non-FDNY-Eagles (Unmodified START)	Correctly Triaged		Over Triaged		Under Triaged	
Overall	2,681	87.1%	149	4.8%	250	8.1%
Black	108	98.2%	N/A	N/A	2	1.8%
Red	384	69.8%	0	0.0%	166	30.2%
Yellow	861	87.0%	47	4.8%	82	8.3%
Green	1,328	92.9%	102	7.1%	N/A	N/A

Table 2. Triage Accuracy Using START and FDNY-START (28 scenarios)
Abbreviations: EMS, Emergency Medical Services; FDNY, Fire Department of the city of New York; START, Simple Triage and Rapid Treatment.

whereas non-FDNY-Eagles providers correctly triaged 87.1% of cases using START. The FDNY over- and under-triage rates were 3.9% and 4.9%, respectively; whereas over- and under-triage rates for the non-FDNY-Eagles group were 4.8% and 8.1%, respectively (Table 2).

Overall, in the FDNY-EMS group, Red was correctly triaged 86.9%, Orange 86.3%, Yellow 94.9%, and Green 92.5% of the time. Red, Orange, and Yellow were under-triaged in the FDNY-EMS group at a rate of 13.1%, 12.2%, and 1.4%, respectively (Table 2). In the non-FDNY-Eagles group, Red, Yellow, and Green patients were correctly triaged 69.8%, 87.0%, and 92.9% of the time, and were under-triaged 30.2%, 8.3%, and N/A for Green, respectively (Table 2). Both groups had comparable rates for correctly identifying Black tags (98.2% non-FDNY-Eagles vs 97.7% FDNY-EMS).

Additional analyses were performed to determine if there were variations in triage accuracy using FDNY-START exclusively within the FDNY-EMS group. The FDNY-EMS did not show variations in triage accuracy either by position (emergency medical technician (EMT)/paramedic/officer) or by years of EMS service (not shown). Similar information was not available for the non-FDNY-Eagles group. For the FDNY-EMS group, the authors further stratified analysis based on whether the provider was hired within the last two years (the time during which FDNY-START has been in use), attempting to gauge whether prior experience with unmodified START impacted performance with FDNY-START (not shown). Again, no significant variations were found in triage accuracy by year of hire.

Discussion

Under- and over-triage remain important challenges to pre-hospital providers in MCI settings and can lead to higher mortality rates for the most critically injured.[18] Under-triage occurs when severely injured patients are incorrectly placed in a

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lower, less-urgent category. Negative patient outcomes may occur because careful monitoring, immediate stabilization and treatment, and prioritized transport may not be available for these lower priority categories. Over-triage occurs when less severely injured patients are incorrectly placed in a higher, more urgent category. When there are few cases, over-triage allows borderline cases to receive a higher level of care, but for a true MCI with numerous patients, as would occur at natural or man-made disasters, over-triage will ultimately diminish limited resources for critically ill patients and lead to prolonged transport times and delays in life-saving interventions for those most in need.

The specific subgroups of FDNY and non-FDNY-Eagles EMS analyzed were comparable based on their triage accuracy scores for the 23 case scenarios where an Orange Tag was not the correct answer (92.2% FDNY vs 88.3% Eagles), and were similar for the overall percentage of correct triaging for all 28 cases (91.2% FDNY vs 87.1% Eagles). The FDNY over- and under-triaged slightly less that the Eagles; however, when comparing responses on the five cases for which Orange was the correct designation for FDNY under modified START, the FDNY-EMS performed better (86.3% vs 81.5%), despite having more choices.

When the under- and over-triage of the two EMS groups in the five questions where Orange is the correct response for FDNY-EMS were compared, the authors saw large discrepancies in over-triage and under-triage rates: Eagles over-triaged 17.3% vs 1.5% over-triage for FDNY. Transporting all injured patients to Level 1 trauma centers limits the availability of these centers for those who really need this level of care. On the other hand, the Eagles under-triaged only 1.3% vs FDNY's 12.2%. Most of the FDNY-EMS under-triaged responses (65%) were given a Green (ambulatory) designation (questions 22, 23, 29; Appendix, available online only). The authors suspect this was due to the unmodified START categorization that mandated "Green" for ambulatory patients, without consideration of comorbidities. The FDNY–START is superior to START in that it does not assume that all ambulatory patients are stable and should be categorized as Green, but rather some should be categorized as Orange. Based on this trial's results, the authors plan to address this with additional focused training to stress that even ambulatory patients must be triaged for potential Orange conditions.

There has been an effort to reduce the variability of the triage decision-making process with the use of computer-aided technologies.[16,17] Challenges with implementation and feasibility of these complex triage algorithms limit their real-world application at the scene of an MCI or disaster. Similarly, because they are difficult to operationalize without reliance on computer-based algorithms, there is a paucity of prospective studies demonstrating the efficacy of these methods. In contrast, FDNY-START seeks to reduce the variability in field triage with the integration of an additional category (the Orange Tag) that is easily taught and does not require computer-based algorithms. This represents a step forward in MCI management by potentially increasing the overall accuracy of field triage, thus optimizing categorization, treatment, and transport without the need for advanced technology or extensive retraining. In fact, in this analysis of FDNY personnel, the authors failed to demonstrate differences in triage accuracy either by position (EMT/paramedic/officer) or by years of service, supporting the concept that FDNY-START can be implemented in the field with consistent results across rank and experience.

Limitations

The most important study limitation is the lack of pertinent information (age, gender, years of service, training, and experience) about the non-FDNY-Eagles comparison group. While the authors examined these characteristics within the FDNY-EMS group and found that they were not associated with triage accuracy, it is recognized that this may not be the case for the comparison group, which was also considerably smaller than the FDNY group. Therefore, differences in accuracy of triage can not necessarily be attributed to the addition of an added trauma category (Orange Tag). The authors attempted to address the potential lack of comparability by restricting the analyses to those who scored within the same range on the non-Orange triage scenarios in both EMS groups. Other study limitations are inherent to the assessment of EMS algorithms in general. These include the challenges of implementing system-wide changes to EMS protocols, training personnel, difficulty of prospective analyses in EMS systems, and the impracticality and ethical challenges of randomization during real-world MCIs. Further, the authors acknowledge that performance during a simulated exercise may differ from performance in a crisis setting. Despite these limitations, however, each group was presented with the same 28 patient scenarios and allotted the same amount of time to select an appropriate triage category for each case.

Conclusion

The FDNY has used FDNY-START since 2012. In the busiest EMS system, personnel have been able to rapidly learn its use and effectively apply it in the field. The Orange category permits providers to prioritize casualties into an intermediate triage category properly aligned to meet patient needs, and as such, may reduce the rates of under- and over-triage in comparison with the unmodified START. The FDNY-START also decreases the variability in patient sorting while maintaining high field utility and feasibility without the need for calculations or data input that may be unrealistic to perform in real-world MCI scenarios. The authors believe that during actual MCIs, FDNY-START has streamlined patient care while potentially improving patient outcomes in a heterogeneous civilian population where exacerbations of medical comorbidities are encountered frequently. Comparison of these triage algorithms at actual MCIs is still needed to confirm this hypothesis, but initial feedback is promising, leading the authors to believe that FDNY-START can improve triage with minimal, if any, additional cost.

Supplementary materials

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1049023X14001447

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