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Comparative analysis of START and TST medical triage patterns among active firefighters

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ABSTRACT

INTRODUCTION: Incidents involving a large number of casualties pose a huge challenge for medical staff. The use of triage protocols facilitates operations at the scene of an incident. There are currently many different triage protocols in use worldwide. In Poland, the START system is used. At the scene of an incident, initial triage may be carried out not only by medical personnel but also by Qualified First Aid responders. These are most often officers of the State Fire Service. The aim of the analysis is to compare the results of the two triage systems, START and TST, amongst active firefighters.

MATERIALS AND METHODS: The analysis was based on the results obtained from 78 firefighters from the State Fire Service, from units in the Mazowieckie, Lubelskie and Podlaskie Voivodeships. The study was conducted in several stages. An optimal triage set was prepared, the injured were characterized and a unified assessment system was introduced. The Pearson and Rho-Spearman tests were used in the study. The significance level of the tests was set at $p < 0.05$.

RESULTS: Officers triaged casualties more quickly using the TST protocol (mean = 158 sec.) than the START protocol (173 sec.). For both protocols, a significant correlation was observed with the time taken to carry out triage ($p < 0.05$). Accuracy was not significantly dependent on length of service ($p > 0.05$). In the case of the START system, respondents most frequently described it as 'simple' ($n=35$; 45%) to learn. Those using the TST scheme most often described it as 'rather simple' ($n=32$; 41%). More than half of the officers would prefer to use the TST scheme ($n=59$; 76%).

CONCLUSIONS: Firefighters took less time to sort items using the TST system. Greater professional experience was not associated with shorter sorting times. Respondents using the TST system achieved a higher accuracy rate in item classification. Firefighters prefer to carry out sorting using the TST method. Those using the TST method reported higher levels of satisfaction after completing the sorting task. Further research into sorting methods amongst firefighters should be considered.

KEY WORDS: Triage, START, TST, firefighter, system, education.

INTRODUCTION

In 2025, the National Centre for Emergency Medical Services Monitoring recorded 26 incidents in Poland involving a large number of casualties [1]. These are situations that require emergency responders not only to possess practical skills, but also to coordinate the activities of multiple services effectively. The efficient determination of the number of casualties and their condition enables the appropriate deployment of additional personnel and resources, as well as the designation of dedicated hospitals. Information relayed from the incident scene to hospital accident and emergency departments (ED) allows staff to prepare the necessary equipment or wards for incoming patients. This was observed during a disaster simulation in Magnuszew [2]. The use of colour-coded and numerically coded diagrams speeds up the prioritisation of medical care for casualties.

There are many triage schemes available. In Poland, the START (Simple Triage And Rapid System) system is used [3]. Triage is usually carried out using special wristbands, cards or by marking the patient with a pen in a visible place [4]. The casualty is assigned one of four colours and/or numbers corresponding to their condition [5] (Fig. 1). A person assigned the colour red and/or the number 1 should be placed under the care of medical staff as soon as possible. A casualty who should be treated second is marked with the colour yellow and/or the number 2. The colour green and/or the number 3, on the other hand, indicates a person who can wait at the scene and does not require urgent medical attention. The colour black and/or the number 4 indicates a casualty to whom the resources and personnel present at the scene are unable to provide adequate assistance.

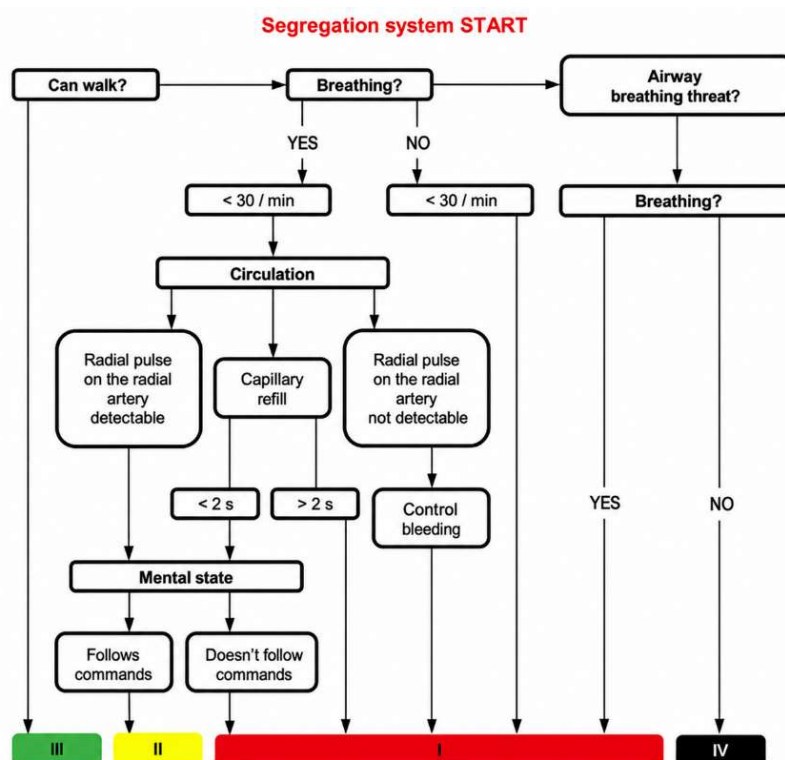


Figure 1. The START triage system [9].

A similar classification system is used in the TST (Ten Second Triage) system [6]. Under this scheme, the casualty is also assigned one of four colours and/or numbers (Fig. 2). Using this system, paramedics are able to determine the casualty's transport and treatment priority within 10 seconds.

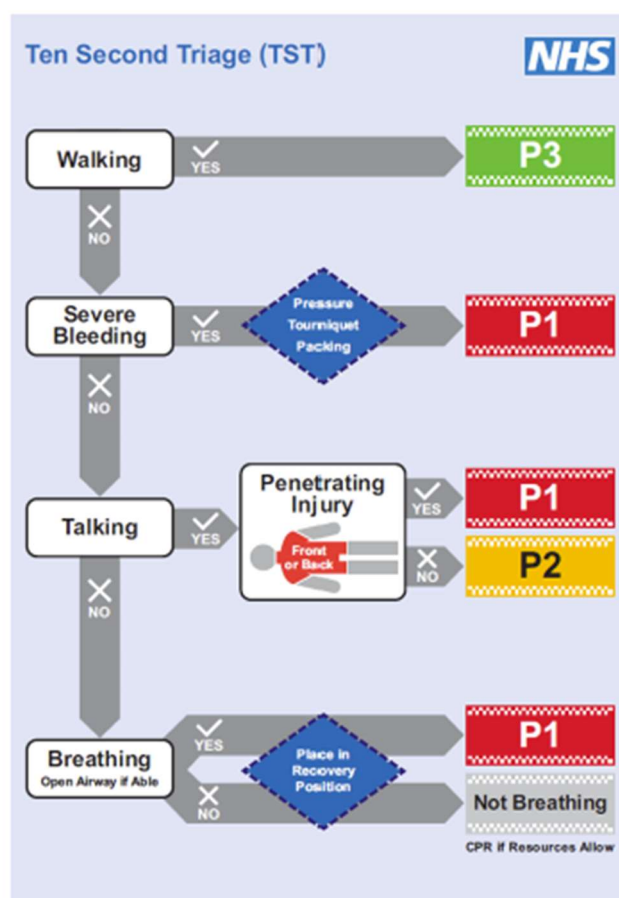


Figure 2. Diagram of TST segregation [6].

In Poland, primary triage may also be carried out by Qualified First Aid (QFA) responders [7]. These are individuals who have successfully completed a training course and possess up-to-date knowledge. Each first-aider is required to undergo recertification every three years. Thanks to the knowledge they have acquired, QFA first-aiders can effectively stop bleeding or perform cardiopulmonary resuscitation [8]. Operations at the scene are often supported by officers of the State Fire Service (PSP), who undertake the QFA course whilst still at school [9]. In addition, firefighters have the equipment necessary to stabilise the condition of an injured person until they are taken over by emergency medical services.

The aim of the study is to compare the effectiveness of the START and TST classification schemes amongst active firefighters. The analysis focused on the speed at which classification was carried out using the schemes under investigation. Attention was also paid to the impact of professional experience on classification amongst officers of the State Fire Service.

MATERIALS AND METHODS

The comparative analysis was carried out following approval from the Research Ethics Committee of the University of Siedlce (No. 11/2024 dated 2 December 2024). The study involved 78 firefighters from the State Fire Service, drawn from units in the Mazowieckie, Lubelskie and Podlaskie Voivodeships.

The study was divided into five stages. At the outset, each firefighter gave their consent to participate in the project, thereby being assigned a participant number. After completing a socio-demographic questionnaire, which covered age, length of service and previous experience of triage, each participant completed a self-assessment of their theoretical and practical skills. The final element of the first stage was a lecture describing the schemes under analysis.

In the second stage, the officers were randomly divided into two groups; half were to carry out triage using the START system, and half using the TST system. Each group worked with the same set of casualties: three standardised patients and three simulators. For the purposes of the simulation, each casualty was given an appropriate characterisation illustrating the injuries sustained. A description of the casualties' condition is set out in Table 1.

Table 1. Description of the condition of the casualties used during the simulation, together with the relevant coding.

Patient	Physical injuries	Ability to walk	Verbal communication	Respiratory rate	Capillary refill time	Radial pulse	START classification	TST classification
1. bleeding from forearm	heavily bleeding laceration on the forearm	inability	Preserved	25/min	1 s	present	yellow „2”	red „1”
2. chest injury	no external injuries, bruising and asymmetry in the chest elevation	inability	none	35/min	3 s	absent	red „1”	yellow „2”
3. head injury	minimally bleeding laceration on the eyebrow ridge	inability	preserved	10/min	3 s	absent	red „1”	yellow „2”
4. abrasion, scratches	abrasions on the hand, scratches on the face, dried blood near the nose	inability	none	none	6 s	absent	black „4”	black „4”
5. bruising	bruising on the forearm	ability	preserved	20/min	1 s	present	green „3”	green „3”
6. amputation	amputation of the forearm	inability	none	none	5 s	absent	black „4”	red „1”

Before the practical task, the firefighters were given a card showing the relevant sorting scheme and a kit to carry it out. In order to standardise the triage kits, the study authors carried out market research. This was based on offers from five different online shops, the contents of which are shown in Figure 3. The bag used during the simulation contained colour-coded wristbands, a marker pen, gloves, summary cards and a pair of scissors.

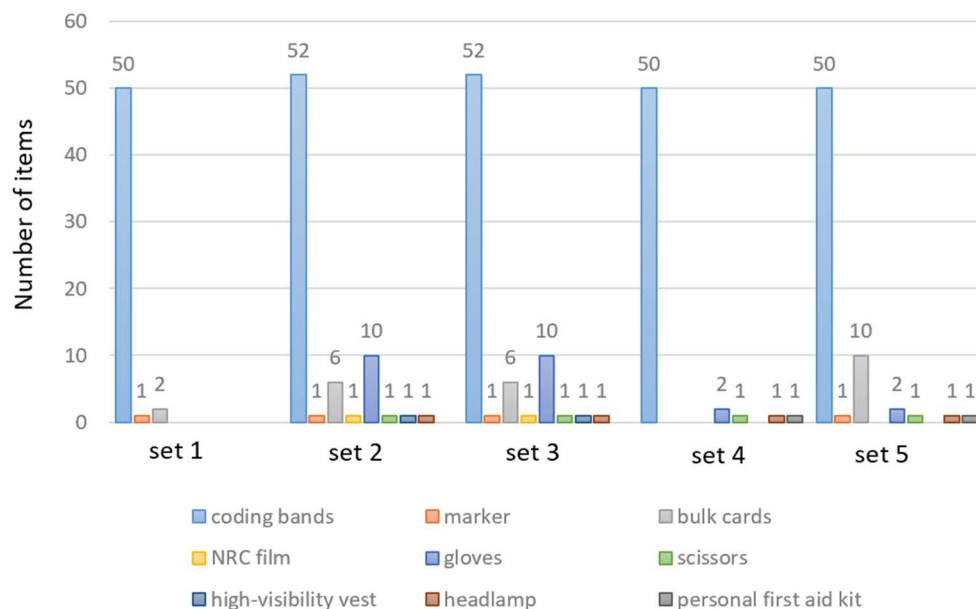


Figure 3. Contents of 5 triage kits.

After familiarising themselves with the layout of the available equipment, the firefighters moved on to the third stage of the assessment. One by one, they went into a separate room where they began the simulation. Each officer carried out the task using either the START or TST protocol, chosen at random, with the aid of a card detailing one of the triage systems. If any doubts arose whilst carrying out the task, the test organisers provided an answer specifying the condition of the casualty.

The fourth stage involved completing another self-assessment form setting out the officers' subjective views on their theoretical and practical knowledge, as well as filling in a questionnaire. In this questionnaire, the firefighters indicated their level of satisfaction with the task and were also given the opportunity to share their conclusions.

In the final stage, the researchers discussed the condition of the casualties and how they should be classified according to the analysed protocols. Each firefighter was also given the opportunity to view their results. The participants were shown their results individually.

The study was conducted in several stages. An optimal triage set was prepared, the injured were characterized and a unified assessment system was introduced. The Pearson and Rho-Spearman tests were used in the study. The significance level of the tests was set at $p < 0.05$.

RESULTS

Characteristics of the study group

The study involved 78 firefighters from Fire and Rescue Units in the Mazowieckie, Lubelskie and Podlaskie provinces. The results of 77 men and 1 woman were subjected to comparative analysis. Their mean age was 34 years ($SD=8.09$). The vast majority of the study group reported having more than 10 years' service ($n=37$; 47.7%).

Assessment of segregation accuracy

The accuracy of segregation was assessed according to the procedure the officers followed during the simulation.

Casualty No. 1

A person with active bleeding from the forearm and normal vital signs according to the START protocol should be classified as yellow. More than half of the firefighters ($n=24$; 62%) carried out the triage correctly. The remaining firefighters chose red ($n=9$; 23%) and green ($n=6$; 15%). In the case of the TST scheme, this casualty should be assigned the colour red, as indicated by the majority of firefighters ($n=26$; 67%). A similar number of respondents assigned the colours yellow ($n=9$; 23%) and green ($n=4$; 10%).

Casualty No. 2

According to the START protocol, a person with a closed chest injury should be assigned the colour red. The vast majority of firefighters ($n=38$; 97%) carried out the correct triage. Only one respondent assigned the colour green to this casualty ($n=1$; 3%). No other codes were assigned. The TST scheme classifies this casualty as priority number 2. Only 15 per cent ($n=6$) of respondents indicated the correct classification. The vast majority of firefighters assigned the casualty code number 1 ($n=29$; 74 per cent). Only 3 (8%) officers chose the colour black.

Casualty No. 3

A casualty with a head injury and abnormal vital signs, as per the START algorithm, should be given the highest priority for transport and treatment. More than half of the respondents ($n=25$; 64%) correctly identified the triage code. Nearly 30% of firefighters ($n=11$) assigned the colour yellow, whilst only 8% of respondents ($n=3$) chose green.

Under the TST system, this person should be assigned the colour yellow. Almost 60 per cent of firefighters (n=23; 59 per cent) identified this correctly. Code 1 was selected by 11 firefighters (28 per cent), whilst code 3 was chosen by only 5 respondents (13 per cent).

Casualty No. 4

Both systems assign the colour black to a person with no vital signs and visible abrasions and scratches. More than half of the firefighters using the START system (n=24; 62%) carried out the triage correctly. The remaining respondents chose code number 1 (n=15; 38%). The vast majority of firefighters using the TST system correctly classified the casualty (n=29; 74%). Only 20% of firefighters (n=8) chose to assign the red code. One respondent each (n=1; 3%) assigned the yellow and green codes.

Casualty No. 5

In the case of a person who was moving and had visible bruising on an upper limb, both protocols assigned the colour green. When using the START protocol, as many as 85 per cent (n=33) of the participants correctly assigned the code. Only 6 firefighters (15 per cent) chose to assign code number 2. Using the TST scheme, 34 respondents (87%) carried out the correct classification. Only 5 firefighters chose the colour yellow (13%).

Casualty No. 6

A casualty with no vital signs and a visible upper limb amputation was assigned the colour black according to the START scheme. More than half of the firefighters (n=22; 56%) carried out the triage correctly. A similar number (14; 41%) assigned code 1. The TST scheme, however, classified the casualty as red. Twenty-three firefighters (59 per cent) carried out the triage correctly. Only 41 per cent (n=16) of the officers assigned the black colour.

Assessment of satisfaction levels

Using a 7-point Likert scale (from -3 to +3), the firefighters rated their level of satisfaction with taking part in the study. Firefighters most frequently indicated a 'rather high' level of satisfaction, regardless of the scheme they used for triage. In the case of the START method, firefighters rated their average level of satisfaction at 0.90 points. Firefighters carrying out the task using the TST system rated their average level of satisfaction 0.2 points higher (average = 0.92).

Selection of the preferred system

One of the final sections of the questionnaire involved selecting one of the schemes. Based on the lecture they had attended, the practical task they had completed and their own experiences, each firefighter chose the system they considered to be better. Among the respondents who carried out triage using the START system, only 15 (38 per cent) would prefer to use it.

After carrying out triage using the TST scheme, as many as 90 per cent of the firefighters (n=35) preferred to use it. Among all respondents, the overwhelming majority would prefer to carry out triage using the TST scheme (n=59; 76 per cent) (Fig. 4).

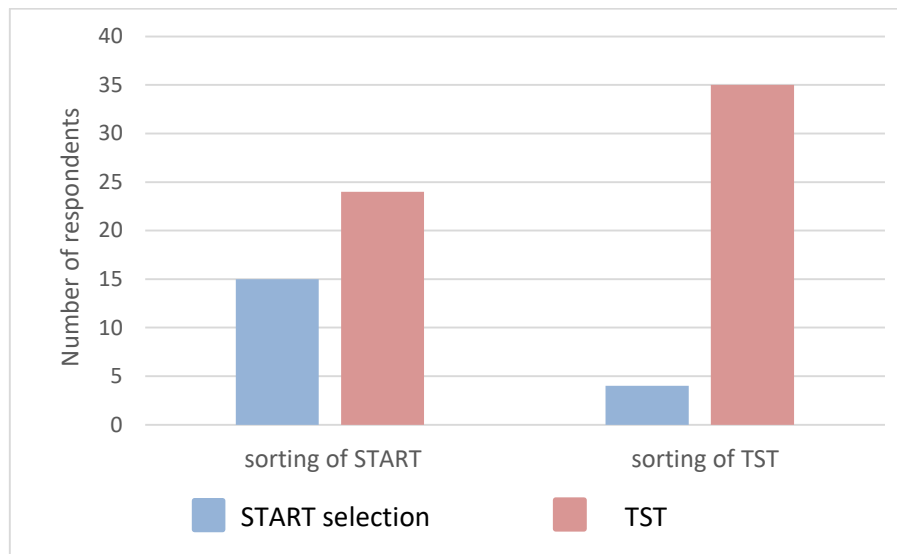


Figure 4. Comparison of triage schemes.

Conclusions drawn by officers

Each participant was given the opportunity to share their conclusions following their participation in the project. The authors of the study have chosen to present a few of those most relevant to the nature of the study.

1. *"TST is definitely an easier way to carry out triage; it means spending less time with each casualty, which means we can help more people in a relatively shorter time."*
2. *"The TST system seems simple, but the difficulty lay in matching the wristband to the casualty; the diagram lacked additional information, which left me in doubt."*
3. *"The TST system offers a huge time advantage, and if someone struggles with stress, there are fewer factors to remember, which can clearly have an impact on stress levels."*
4. *"The TST system is easier to learn and simpler to use, which helps to reduce stress when carrying out triage."*
5. *"I prefer the Start system because it provides more detail when categorising casualties, which reduces the risk of leaving a casualty without assistance."*
6. *"The TST system is simpler, quicker, less complicated and much less complex."*

Assessment of ease of comprehension

Officers were again asked to use a Likert scale (from -3 to +3) to rate the ease of comprehending the diagrams. In the case of the START system, the majority of firefighters (n=35; 45%) described it as 'simple'. In the case of the TST diagram, officers were more likely to describe it as 'rather simple' (n=32; 41%).

Analysis of self-assessment results

Before commencing the practical part and after completing the task, officers completed identical self-assessment questionnaires (on a scale from -3 to +3 points). Among those carrying out sorting using the START system, the average score for theoretical knowledge prior to the test (Mean = 0.7; SD = 0.80) was similar to that recorded after the simulation (Mean = 0.8; SD = 0.90). In the case of those using the TST system, the authors observed no difference in the mean theoretical score. In both cases, it stood at 0.7 points.

Practical skills were assessed in a similar manner. In the case of firefighters operating according to the START protocol, a decrease in average satisfaction of 0.1 points was observed following the simulation (Mean = 0.5). Among the respondents, the opposite was observed. There was an increase in self-assessment of 0.1 points following the sorting exercise (Mean = 0.7).

In the case of stress levels prior to the practical task, officers using the START scale most frequently rated them at -0.2 points. After the exercise, this level fell by an average of 0.3 points. Firefighters carrying out the task using the TST system rated their average stress level at -0.2 points both before and after the simulation.

Different results were observed in the case of stress associated with providing assistance to casualties. Participants using the START system rated their stress level at an average of -0.2 points. The authors did not observe any difference between the results recorded before and after the simulation. Officers operating under the TST scheme rated their stress level on average 0.2 points lower after completing the practical task (average = -0.2 points).

Analysis of triage completion times

When analysing triage completion times, the study's authors took into account the protocol used in the simulation, as well as the officers' length of service. It was observed that the average time for the group carrying out triage according to the START system (173 sec.) was 15 seconds longer than that of those following the TST protocol (158 sec.).

Among the officers using the START protocol, the shortest average time was achieved by those with 5–10 years' service (156 seconds). Firefighters with more than 10 years' service required only slightly more time (164 seconds). Triage using the START system took by far the longest time (209 seconds) for those

with less than 5 years' service. Among firefighters carrying out the simulation using the TST system, those with more than 5 years' service performed best (150 seconds). Firefighters with 5–10 years' service (161 seconds) and those with more than 10 years' service (163 seconds) completed the triage in a similar amount of time.

The authors of the study established a correlation between the scheme and the time taken for the sorting task. Using Spearman's Rho test, statistical significance was observed between the START ($p < 0.05$) and TST ($p < 0.05$) schemes and the time taken to complete the task (Fig. 5).

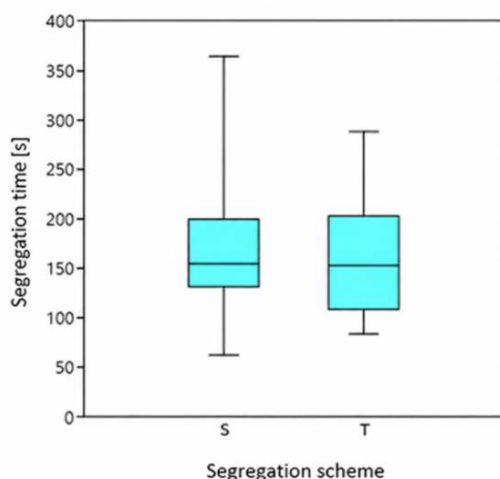


Figure 5. Correlation between the START (S) and TST (T) schemes and the time taken to carry out triage.

Using Pearson's test ($p > 0.05$), no significant correlation was observed between length of service and the time taken to carry out triage (Fig. 6).

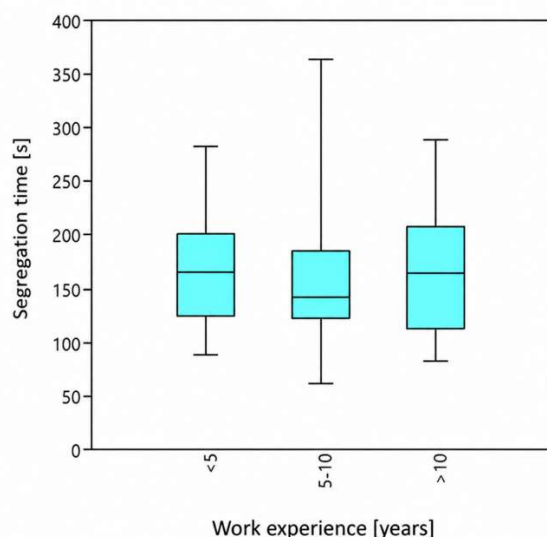


Figure 6. Relationship between length of service and segregation time.

When analysing the results of firefighters who undertook training whilst on duty compared with those who did not have this opportunity, no statistical significance was observed ($p > 0.05$) (Fig. 7).

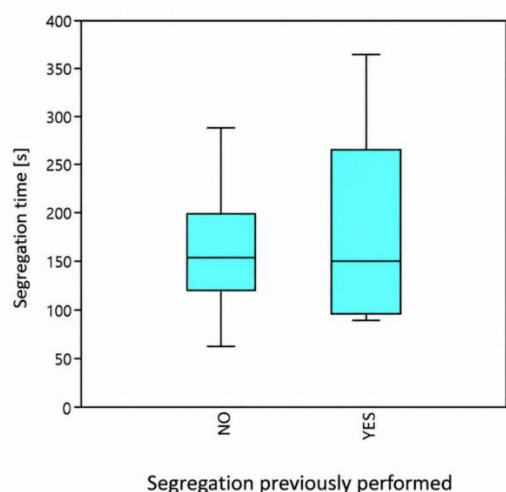


Figure 7. Correlation between triage carried out earlier and the time taken for patient sorting.

The correlation between mastery of the START and TST protocols was statistically significant ($p < 0.05$) (Fig.8). A lower score indicated less difficulty among officers.

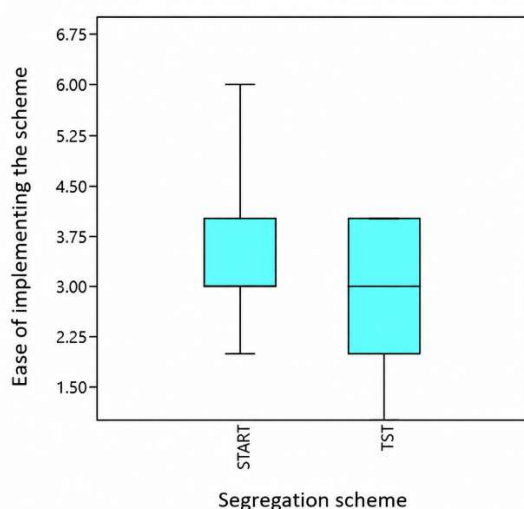


Figure 8. Correlation between ease of implementation and triage version.

DISCUSSION

Triage is a key element of on-scene operations. In many cases, firefighters are the first to arrive and, after securing the scene, assist the injured, including by carrying out a trauma assessment [10]. A Rescue Operations Commander (KDR) is appointed from among the dispatched fire brigade units. Their role is to coordinate the activities of the available personnel and resources.

He cooperates not only with the Medical Operations Commander (KAM), but also with additional services and specialists called to the scene, as was the case during the 2006 construction disaster at the

Katowice International Fair. During the operations at the scene, not only were there numerous fire brigades and emergency medical teams in action, but also soldiers from the Polish Army and construction workers [11, 12]. Coordinating so many different services poses a huge logistical challenge [13].

Emotions that may affect the quality of actions present a further challenge. The triage diagram can influence stress levels whilst assisting casualties. One of the respondents observed: 'The TST system is simpler, quicker, less complicated and much less elaborate.' However, the appearance of the diagram did not affect the accuracy of triage. It was noted, however, that the structure of the system influenced the time taken by firefighters to complete the task. Those using the TST system achieved, on average, a shorter triage time than the respondents using the START system. In order to improve the triage carried out by firefighters, it is worth considering further research into comparing the effectiveness of the TST system. At present, the lack of sufficient data does not allow for a clear determination of the application of the TST scheme in the professional practice of firefighters.

A correlation between length of service and the time taken to carry out triage revealed that the time taken to conduct triage does not decrease with greater professional experience. The small number of call-outs requiring triage prevents officers from gaining practical experience. Training helps to improve operations at the scene of an incident. Increasing the number of courses and practical exercises will improve the effectiveness and speed of decision-making.

A lack of experience may also exacerbate anxiety associated with segregation. The level of stress reported by the participants varied depending on the system used. Firefighters who carried out the simulation according to the TST protocol reported, on average, the same level of stress both before and after the task. In the case of the group of officers using the START system, this figure increased after the practical part. The structure of the protocols may have influenced this result. One of the respondents noted: *"With the TST system, there is a huge time advantage, and if someone has a problem with stress, there are fewer factors to remember, which can clearly have an impact on stress levels."*

When specifying their preferred scheme, officers more often chose the TST. Lower stress levels, the accuracy of the sorting process, and the structure of the diagram were likely among the factors determining their choice. However, despite the many advantages observed, officers expressed concerns regarding its use. Speeding up triage may affect its accuracy and effectiveness. One firefighter pointed out: "I prefer START because it provides more detail in the categorisation of casualties, which reduces the risk of leaving a casualty without assistance."

Limitations of the study – the size of the study group does not allow for definitive conclusions to be drawn. Furthermore, the study was conducted solely amongst active professional firefighters. A comparative

analysis of the systems should also be carried out amongst individuals authorised to carry out triage but who are not officers of the State Fire Service. The lack of available research on the use of the TST scheme limits the possibility of comparing it with other schemes.

CONCLUSIONS

On average, officers took less time to carry out triage using the TST protocol (158 sec.) than the START protocol (173 sec.). Greater accuracy in the case of 6 casualties was observed in the group using the TST protocol. Officers found the START protocol easier to learn. Most officers would prefer to carry out triage using the TST scheme. Those who carried out triage using the TST system reported a higher level of satisfaction with their participation in the study. It is worth considering further research comparing the START and TST triage schemes amongst active firefighters.

SUPPLEMENTARY INFORMATION

Funding: No fund was received related to this study.

Institutional Review Statement: The study was conducted according to the guidelines of the Declaration of Helsinki.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

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