

Comparison of the effectiveness of selected medical segregation systems - START, SIEVE, CAREFLIGHT.



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ABSTRACT

INTRODUCTION: In the face of sudden events with many victims, various types of medical segregation systems were created. Their aim is to set the treatment and transport priority of patients by giving them appropriate urgency codes considering their general condition and vital parameters. The study is aimed at comparing the effectiveness of selected medical segregation systems.

MATERIAL AND METHODS: The research tool consisted of one hundred virtual patients, whose condition was categorized according to the START system (Simple Triage and Rapid Treatment) for four urgency codes - 25 persons for each of four categories. Then they were segregated by assigning the wounded to individual urgency codes using the SIEVE and CAREFLIGHT systems. To the statistical analysis was used the Mann-Whitney U test. All results were considered significant at $p < 0.05$.

RESULTS: Among 100 patients using the SIEVE system, 25 were identified in green and black code, 27 in yellow code and 23 in red code. Using the CAREFLIGHT system, 25 patients were shown in green and black code, 31 in yellow code and 19 in red code. There were no differences between segregation systems between green and black code patients (Code 3 and 4: START = 25 vs. SIEVE = 25 vs. CAREFLIGHT = 25). In contrast, the yellow code showed differences in the SIEVE system compared to the control group - START system ($p = 0.005$, Code 2: START = 25 vs. SIEVE = 18), which, however, was not demonstrated in relation to CAREFLIGHT (Code 2: START = 25 vs. CAREFLIGHT = 25). In the red code showed differences between the control group and the SIEVE system ($p = 0.001$, Code 1: START = 25 vs SIEVE = 16), and the CAREFLIGHT system ($p = 0.010$, Code 1: START = 25 vs. CAREFLIGHT = 19)

CONCLUSIONS: The effectiveness of selected medical segregation systems (START, SIEVE and CAREFLIGHT) is significantly different among patients in yellow and red code. Taking into account the highest urgency code, the most sensitive selection is shown by the START system, and the least sensitive - CAREFLIGHT.

KEY WORDS: Medical segregation, triage, START, SIEVE, CAREFLIGHT

INTRODUCTION

The history of medical segregation dates back to 1792. Then in France, Baron Dominique Jean Larrey, who was the chief surgeon of the Imperial Guard of Napoleon, contributed to the concept of subjecting "sorting" people who were wounded during the ongoing war, taking into account the damage they suffered during the fight [1]. The activities were aimed at systematizing the organization of medical help on the battlefield and helping as many soldiers as possible to survive. During the First World War, the term "triage" was commonly used for the medical segregation of the victims, which is still used in rescue units.

Nowadays, there are more and more different sudden events, such as mass road accidents, catastrophes, cataclysms or terrorist attacks. They most often cause injuries to victims, sometimes posing a threat to life. Several or even several hundred victims may take part in this type of incident. Medical segregation systems that are used by rescue units, classify the injured in terms of the urgency of therapeutic and transport procedures are extremely helpful for emergency services [2]. They are used not only on the site of the incident but also in the structures of medical facilities (eg hospital emergency department) [3].

There are many medical segregation systems in the world such as START, SIEVE, CAREFLIGHT, SAVE, STM etc. Each of them has the role of enabling the survival of as many people as possible. This is done by determining the priority of treatment and transport by emergency services based on the general condition of the wounded. The person conducting the triage qualifies the injured person for a given urgency code, giving it, for example, a color codification, taking into account the severity of injuries, health and prognosis. Depending on the segregation system used and the place of its application, the number of urgency codes, and thus colors, may vary.

The well-known system of medical segregation is START, which to give the right color (urgency code) takes into account such factors as: patient walking, breath with its frequency, presence of pulses on the radial artery, duration of capillary recurrence and doing simple instructions by the injured. The system assumes the division of the victims into four categories marked with color. The green color is given to a person able to move independently. Patient not walking with normal life parameters and achieving orders -

the yellow color, while with disturbances of any of the mentioned parameters - the red color. The sufferer with no breath and heart rate is considered dead, so he receives a black color. The colors are determinants of the curative and transport priority, with the person with the red color having the highest priority, and with the green color - the lowest [4].

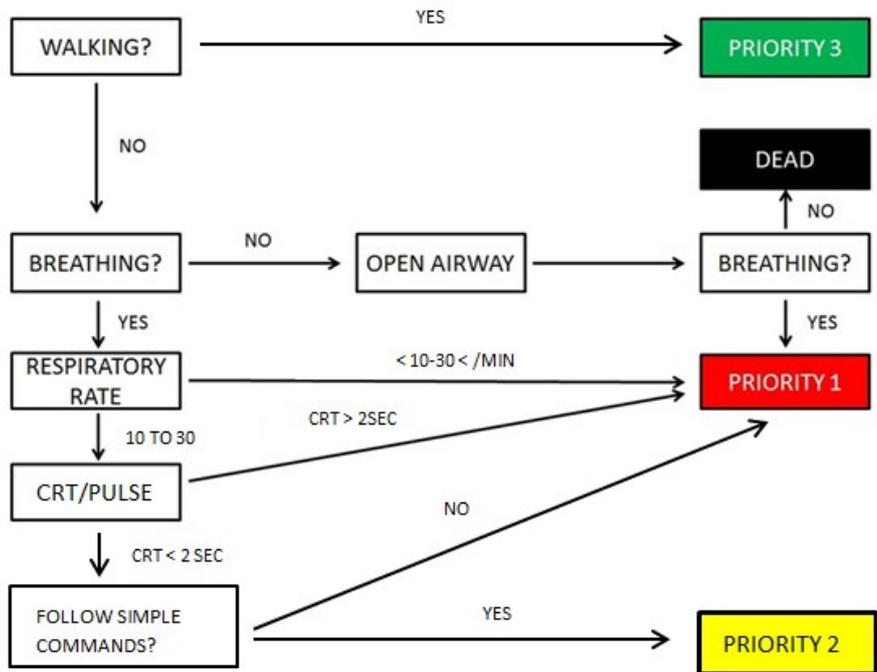


Figure 1. Scheme of the START system.

The SIEVE system consists in examining whether the patient walks, is injured, breathes by himself, needs to open the airways, respiratory rate, heart rate and the time of capillary recurrence [5].

The CAREFLIGHT system consists in determining whether the injured person moves by himself, performs simple commands, breathes with the open airways and has a preserved heart rate on the radial artery [5].

The aim of the work is to determine the effectiveness of selected medical segregation systems (SIEVE and CAREFLIGHT) in comparison to the START system and to indicate intergroup differences among those in a given category. Schemes for testing and categorizing the aggrieved were selected on the basis of a comparable standard for dividing the wounded into four groups.

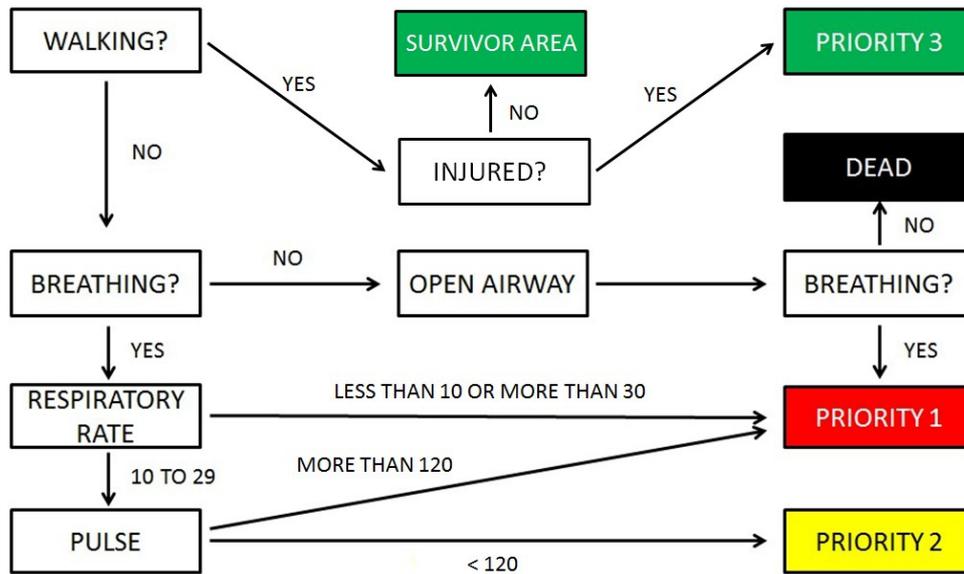


Figure 2. Scheme of the SIEVE system.

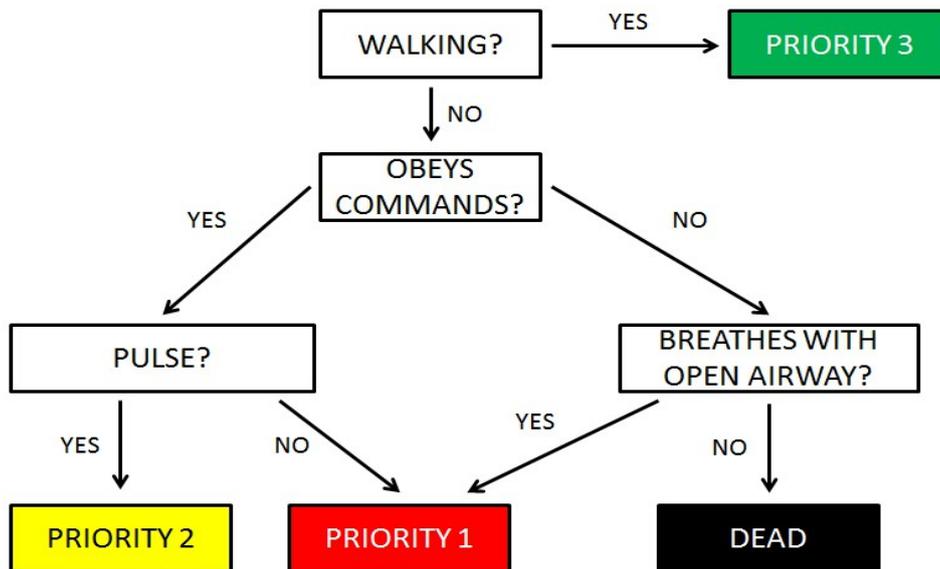


Figure 3. Scheme of the CAREFLIGHT system.

MATERIAL AND METHODS

One hundred patients were developed to determine their general condition, injuries and basic life parameters. 25 cases were selected in four urgency categories: 25 people in red code (1), 25 people in yellow code (2), 25 people in green code (3) and 25 people in black code (4). The control group consisted of patients segregated with the START system. A total of 100 aggrieved were included in the study group, which were segregated according to the SIEVE and CAREFLIGHT system. The normality of the distribution of variables was evaluated by the Shapiro-Wilk and Anderson-Darling tests. Intergroup comparisons were made using non-parametric tests for independent trial (Mann-Whitney U test). The results were considered significant at $p < 0.05$.

RESULTS

SIEVE system

After applying medical segregation of 100 patients with the SIEVE system, the same overall number of aggrieved in the green and black code was compared to the control group (START). In the yellow group, 27 people were categorized and 23 people in the red group. A detailed summary is shown on Figure 4.

CAREFLIGHT system

The final effect of segregation with the CAREFLIGHT system shown the same total number of aggrieved in the green and black categories compared to the control group. A different result in relation to the START group was shown in the red group ($n = 19$) and yellow group ($n = 31$). A detailed summary is shown on Figure 5.

Statistical comparison of medical segregation systems

The normality of the distribution of variables was evaluated using the Shapiro-Wilk and Anderson-Darling test, achieving results at the level of $p < 0.000$. In order to compare groups, non-parametric tests were used due to the lack of normality of variable distribution. Between patients classified in code 3 (green / deferred) and 4 (black) there were no differences between the segregation systems tested (Code 3 and 4:

START = 25 vs. SIEVE = 25 vs. CAREFLIGHT = 25). Among individual patients in category 2 (yellow) and 1 (red), significant differences were found in relation to the control group (START). In the Mann-Whitney U test, the difference was $p = 0.005$ (Code 2: START = 25 vs. SIEVE = 18), but no differences were found between the control group and the CAREFLIGHT system (Code 2: START = 25 vs. CAREFLIGHT = 25). Analyzing the differences in the category of patients in the red code (1), there were differences between the control group and the SIEVE system at $p = 0.001$ (Code 1: START = 25 vs SIEVE = 16) and the CAREFLIGHT system at $p = 0.010$ (Code 1: START = 25 vs. CAREFLIGHT = 19). The number of patients from individual urgency codes, with using selected medical segregation systems, compared to the control group is shown in Table 1.

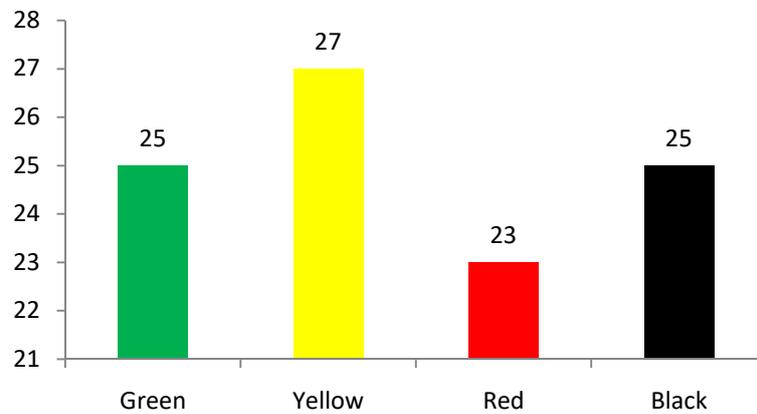


Figure 4. The number of patients in individual colors according to the SIEVE medical segregation system.

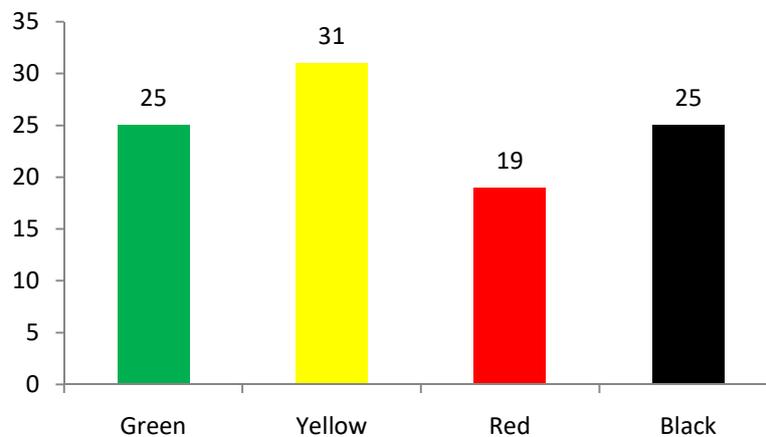


Figure 5. The number of patients in individual colors according to the CAREFLIGHT medical segregation system.

Table 1. The number of assigned colors in patients using SIEVE and CAREFLIGHT medical segregation systems compared to the control group.

CODE	START	SIEVE	CAREFLIGHT
1	25	16	19
		9	6
2	25	18	25
		7	
3	25	25	25
4	25	25	25

DISCUSSION

There are many medical segregation systems in the world affected by mass incidents and disasters. The form of conducting Triage depends on the rules of functioning of the general medical emergency system in a given country. There is, however, insufficient data in the literature, indicating the advantages or disadvantages of selected Triage systems. In Europe, START is one of the most widespread standard. The authors of the study attempted to evaluate selected medical segregation systems in comparison to the START system. These systems were selected, which categorize the victims to four basic groups, depending on the therapeutic and transport priority at the place of the event. The conducted analysis proves that despite slight differences in the total number of victims in the four codes between the tested systems, there are significant differences in the category of wounded qualified as yellow and red [6].

In the SIEVE system in the injured person, in order to give him a given color, the segregating person takes into consideration such elements as: independent walking, basic life functions and injuries. In comparison to the START system, among 100 patients who were appropriately assigned 25 persons to each START code, the SIEVE system showed a significant difference in the yellow category (Mann-Whitney U test; $p = 0.005$) and red category (Mann-Whitney U test; $p = 0.001$).

In the CAREFLIGHT system, if the victim walks and carries out the orders of the medical staff, he receives a green color. In turn, the patient who can't walk but carries out the orders and with preserved breath and pulse receives a yellow color. In the event of wrong in the breath or heart rate, the color is given red, and in the case of people who do not have it – black color. In comparison to the START system, among 100 patients who were appropriately assigned 25 persons to each code, the CAREFLIGHT system showed a significant difference in the red category (Mann-Whitney U test; $p=0,010$).

The study allows us to draw attention to important differences in giving urgency codes to patients, with using the START, SIEVE and CAREFLIGHT medical segregation systems. Available studies indicate attempts to compare other systems as well. One of them showed greater accuracy of segregation using the SMART system towards SALT triage [7]. In turn, the comparison between other segregation systems, namely the Canadian Triage and the Taiwan Triage showed significant differences in the allocation of patients to particular categories [8]. This indicates the various effectiveness of individual systems. However, despite the existence of many systems of medical segregation in the world and research on them, it has not yet been determined which of them would be the best and the most effective [9].

The authors of the study indicated significant differences in the categorization of the injured in yellow and red code, depending on the segregation system used. The main task of Triage is to examine, encode and help those in need who require the most urgent medical intervention. They are then group 1 (red). An overly sensitive segregation system can cause too many patients in the red group to be selected at the scene, making the available forces and resources inadequate. On the other hand, the restrictive requirements for qualifying a patient in the first group may delay the help of those who actually need it.

Analyzing the results obtained, the START system seems to be the most sensitive in the classification of the victims to the red group, and the least to the yellow group. People who are deceased or who are not promising to survive and the green group are equally coded in each of the three models of medical segregation. The segregation scheme should be simple to implement, and at the same time reliable and effective, because it is used by both people with medical education and trained staff [10, 11].

CONCLUSIONS

There are significant differences between the effectiveness of the three medical segregation systems studied. Taking into account the classification of the victims in the first code, the most sensitive system seems to be the START system, and the least CAREFLIGHT system. The authors point to the need to conduct further research to determine which system is the most effective in the matter of reliably allocating the curative and transport priority to the victims.

Disclosure statement

No potential conflict of interest was reported by the author's.

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