Implementation of a surgical screening system for urgent and emergent cases in a tertiary hospital.

Implementação de um modelo de triagem cirúrgica para casos urgentes em um hospital terciário.

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A B S T R A C T

Objective: to evaluate the applicability of the "Timing of Acute Care Surgery" (TACS) color classification system in a tertiary public hospital of a developing country. **Methods:** we conducted a longitudinal, retrospective study in a single center, from March to August 2016 and the same period in 2017. We opted for the selection of four surgical specialties with high demand for emergencies, previously trained on the TACS system. For comparisons with the previous classifications, we considered emergencies as reds and oranges and urgencies, as yellow, with an ideal time interval for surgery of one hour and six hours, respectively. **Results:** Non-elective procedures accounted for 61% of the total number of surgeries. The red, orange and yellow classifications were predominant. There was a significant improvement in the time before surgery in the yellow color after the TACS system. Day and night periods influenced the results, with better ones during the night. **Conclusion:** This is the first study to use the TACS system in the daily routine of an operating room. The TACS system improved the time of attendance of surgeries classified as yellow.

Keywords: Mass Screening. Operating Room Information Systems. Surgery Department, Hospital.

INTRODUCTION

The screening process is extremely important when there are not enough resources for the needs of all patients, especially in reference hospitals in developing countries[1-2]. Screening is commonly applied to catastrophes and emergency relief units. However, in a surgical center scenario, with a large number of elective and non-elective surgeries, there is no standardized nomenclature to classify emergency surgeries. In most hospitals, getting a room for emergency surgery depends on dialogue and negotiation[3]. In others, emergency surgeries are performed in the order of arrival[3-4]. The National Confidential Inquiry into Patient Outcome and Death (NCEPOD) in England classifies surgeries in immediate, urgent, accelerated and elective[5].

In 2013, the World Society for Emergency Surgery Study Group (WSES) recommended the use of a color system to classify emergency surgeries to reduce the loss of information and to allow the establishment of standardized language among the teams. Timing of Acute Care Surgery (TACS) was based on a survey of a panel of specialists about the ideal time for more frequent emergency surgeries[6].

However, since its publication, no study has presented the use of such color classification in the daily dynamics of a surgical center. Therefore, the purpose of this study was to evaluate the applicability of the TACS classification system in a tertiary public and teaching hospital of a developing country with a large number of non-elective surgeries[6].

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METHODS

This is a longitudinal, retrospective, single-center study, held in the periods from March to August 2016 (before implementation of the color system) and from March to August 2017 (after the implementation of color system) at the Botucatu Medical School Hospital. This is a tertiary-level hospital, with 450 beds, responsible for the care of a region with 2 million inhabitants. The surgical center has 14 rooms, 12 for elective surgeries and two for non-elective ones. The rooms for elective surgeries may also be used for non-electives, if necessary, or after they become vacant.

The TACS color classification system (Figure 1) was implemented throughout the surgical center. For this analysis, we selected four specialties with great surgical emergency volume: Digestive System Surgery, Pediatric Surgery, Vascular Surgery and Orthopedics. Before the TACS clssification, we used only two classifications: urgencies and emergencies.

Prior to the implementation, for a period of four months (from November 2016 to February 2017), all teams were trained to use the new, to-be-implemented system.

We compared all non-elective procedures from March to August 2016, the period before the implementation of the color system, with operation up to six hours for urgencies and immediate care

Timing- iTTS **from diagnosis**	Possible Clinical Scenarios(TACS)	Color code	Note
Immediate surgery	Bleeding emergencies		Immediate life saving surgical intervention, resuscitative laparotomy
Within an hour	Incarcerated hernia, perforated viscus, diffuse peritonitis, soft tissue infection accompanied with sepsis		Surgical Intervention as soon as possible but only after resuscitation (within 1 to 2 hours). administration of antibiotics upon diagnosis- no delay
Within 6 hours	Soft tissue infection (abscess) not accompanied with sepsis		Administration of antibiotics upon diagnosis- no delay
Within 12 hours	Appendicitis (local peritonitis), cholecystitis (optional)		Administration of antibiotics upon diagnosis- no delay
Within 24 or 48 hours	Second-look laparotomy		Schedule in advance. Intervention should occur during day time

Figure 1. *Color classification for non-elective TACS (Timing of Acute Care Surgery)[6].*

for emergencies, with the ones in the period from March to August 2017, when the TACS color classification was in effect. For comparison, surgeries previously classified as emergencies were equated with reds and oranges of the color system and those classified as urgencies in 2016, with yellow ones in 2017. We could not compare the procedures classified as green and blue, since these modalities did not have equivalents in 2016.

The ideal time to surgery (iTTs) for emergency care in 2016 was considered six hours and one hour, respectively, as suggested by the World Society of Emergency Surgeries. The relationship between the actual time to surgery (aTTs) and the iTTs was calculated before and after the implementation of the TACS color classification. The time of surgery care is considered satisfactory when this ratio is equal to 1.

We calculated the aTTs/iTTs ratios before and after the implementation of the TACS classification, and compared them using the Student's t-test or the Mann-Whitney test, according to the data distribution, which we analyzed with the Shapiro-Wilk test. The level of significance was 5%. We used a binomial logistic regression to analyze the influence of daytime and nighttime, weekday *versus* weekends, and patient origin (ward *versus* ICU and emergency room).

This study was approved by the Ethics in Research Committee of the Botucatu Medical School (CAAE: 59707416.9.0000.5411).

RESULTS

The non-elective surgeries of the four specialties analyzed accounted for 61% and 61.2% of the total, respectively, in 2016 and 2017. Although there were no changes in the physical structure of the surgical center, in 2017 there was a 7.8% increase in the total number of surgeries. Table 1 summarizes the number of non-elective surgeries among the four specialties in the two years, comparing emergencies with red and orange and urgencies with yellow.

Table 1. *Comparison of non-elective surgeries divided among the four specialties before and after the implementation of the TACS color classification.*

Year	Specialty	Emergencies	Urgencies	p*	Total
2016	Gastroenterology Surgery	186/437 (42.5%)	251/437 (57.5%)	<0.01	1,268
	Pediatric Surgery	58/149 (38.9%)	91/149 (61.1%)	<0.01	
	Vascular Surgery	112/202 (55.4%)	90/202 (44.6%)	0.02	
	Orthopedics	179/480 (37.3%)	301/480 (62.7%)	<0.01	
		Red + Orange	Yellow		
2017	Gastroenterology Surgery	275/476 (57.7%)	201/476 (42.3%)	<0.01	1,381
	Pediatric Surgery	43/100 (43.0%)	57/100 (57.0%)	0.04	
	Vascular Surgery	125/178 (70.2%)	53/178 (29.8%)	<0.01	
	Orthopedics	362/627 (57.7%)	265/627 (42.3%)	<0.01	

** Binomial testing.*

After the implementation of the TACS classification, in 2017, there was a predominance of the classification of surgeries in red, orange and yellow (Figure 2).

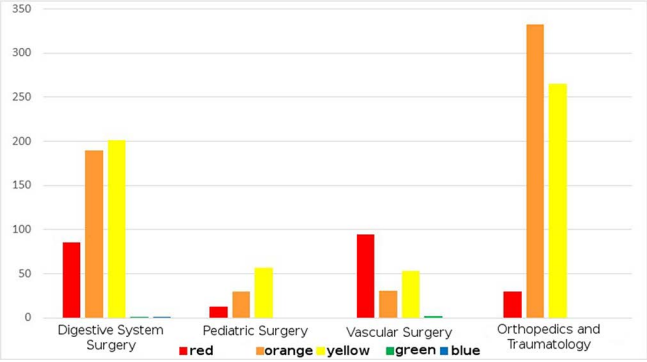

Figure 2. *Total surgeries performed by the four specialties in the period from March to August of 2017, according to the TACS color classification.*

When analyzing all specialties together, the comparison of surgeries classified as emergency *versus* red or orange in 2016 and 2017, respectively, showed that the actual time to surgery (aTTs) was better before TACS (p<0.0001). There was no difference in aTTs in the comparison between emergencies in 2016 and red in 2017 (p=0.98). Regarding the comparison between urgencies in 2016 and yellow ones in 2017, there was a decrease in aTTs (p<0.001). Table 2 shows the same analysis, separated by the specialties.

When analyzing all the specialties were, there was no difference in the relation between the actual and the ideal time to surgery (aTTs/iTTs) before and after the TACS classification (p=0.315).

Table 2. *Analysis of the actual time to surgery (aTTs) before and after the TACS classification among the specialties.*

		Emergency	Red	p
Gastroenterology Surgery	Median (min/max)	120 (50/750)	100 (11/710)	0.050*
Pediatric Surgery	Mean (SD)***	180 (55/535)	160 (41/420)	0.540**
Vascular Surgery	Mean (SD)***	110 (10/600)	118 (20/540)	0.320**
Orthopedics	Median (min/max)	100 (15/785)	114 (16/1142)	0.250*
		Emergency	Orange	p
Gastroenterology Surgery	Median (min/max)	120 (50/750)	130 (7/1040)	0.150*
Pediatric Surgery	Median (min/max)	180 (55/535)	134 (19/705)	0.815*
Vascular Surgery	Median (min/max)	110 (10/600)	150 (40/1360)	0.006*
Orthopedics	Median (min/max)	100 (15/785)	139.5 (20/888)	<0.0001*
		Emergency	Red + Orange	p
Gastroenterology Surgery	Median (min/max)	120 (50/750)	125 (7/1040)	0.660*
Pediatric Surgery	Median (min/max)	180 (55/535)	150 (19/705)	0.907*
Vascular Surgery	Median (min/max)	110 (10/600)	120 (20/1360)	0.063*
Orthopedics	Median (min/max)	100 (15/785)	130 (16/1142)	<0.0001*
		Urgency	Yellow	p
Gastroenterology Surgery	Median (min/max)	240 (56/800)	120 (10/813)	<0.0001*
Pediatric Surgery	Median (min/max)	220 (50/630)	105 (10/1245)	<0.0001*
Vascular Surgery	Median (min/max)	180 (40/900)	115 (14/980)	0.0006*
Orthopedics	Median (min/max)	240 (25/1395)	120 (10/1375)	<0.0001*

** Mann-Whitney test; ** Student's t test; *** SD=standard deviation.*

Table 3 shows the aTTs/iTTs ratio before and after the TACS classification. There was a decrease in this ratio for Pediatric Surgery and an increase for the other specialties.

Surgeries taking place on working days or on weekends, as well as the origin of the patients (ICU and ER versus wards) did not influence the aTTs/iTTs ratio before and after TACS (p=0.914 and p=0.127, respectively). In contrast, the comparison between day and night periods showed better results for the nocturnal periods, with 64.7% of surgeries with a ratio of 1 (p<0.001).

DISCUSSION

This was the first time that the TACS classification was used in the day-to-day operation of a surgical center of a tertiary hospital in a developing country, with a large number of non-elective surgeries (61% of the total). Considering the expressiveness of the number of non-elective surgical interventions, the acquisition of correct information for the triage of surgical cases is a key point to know the specificities and peculiarities of the surgical center[7].

Despite the training on the use of colors in the TACS classification, the green and blue colors were practically not used by the studied specialties. The large number of surgeries and priorities may explain why these less urgent colors were poorly chosen. Although there was no difference in the aTTs/iTTs ratio before and after the TACS classification, there was an increase in the number of elective and non-elective surgeries, without any change in the physical structure of the surgical center, which could indicate a better organization in the surgeries.

The absence of difference in the comparison between emergencies in 2016 and the red color in 2017, and the worsening in the actual time to surgeries when compared to orange emergencies, raise the hypothesis of an incorrect classification of cases severity, requiring the creation of awareness strategies for teams to appropriately screen surgical cases according to the colors classification, performing the procedures in due time[8].

Among the specialties, Pediatric Surgery was the only that obtained improvement in aTTs after the TACS classification. This can be explained by the probable greater adherence to the colors classification,

Table 3. *Analysis of aTTs/iTTs ratio before and after the TACS classification divided among the specialties.*

	Before	After	p
Digestive System Surgery			
N	437	476	-
Median (min/max)	1.17 (0.16/12.50)	1.67 (0.12/11.983)	<0.01*
Pediatric Surgery			
N	149	100	-
Median (min/max)	0.92 (0.14/8.92)	0.67 (0.03/11.75)	0.03
Vascular Surgery			
N	202	178	-
Median (min/max)	1.25 (0.11/10.00)	1.67 (0.04/22.67)	0.03
Orthopedics			
N	480	627	-
Median (min/max)	1.06 (0.07/13.01)	1.17 (0.03/19.03)	<0.01

** Mann Whitney test.*

since one of the authors of this research is of this specialty. Surgeries classified as red and orange have the precedence of using a room intended for routine surgeries, which can cause the classification in these colors without a real indication. On the other hand, the TACS classification was more effective for the cases considered yellow compared with the urgencies in the previous year. Based on these results, the permanent education is active in the teaching-learning process of the working teams, especially for resident physicians, and is implementing measures to check the veracity of the red and orange gradings[9].

Weekends and places of origin of patients did not influence the results. However, the nocturnal period was predictive of a better time of care. This can be explained by the fact that during the day there is a great disproportion between rooms reserved for elective and non-elective surgeries, which does not happen during nights, when there are no elective surgeries. Although the teams were 70% smaller during the nights, the absence of the elective surgeries guaranteed a shorter service time.

It is not possible to establish comparisons of our results with previous studies', because this is the first time this classification is implemented outside a disaster scenario.

We conclude that the TACS rating improved time for surgeries classified as yellow. We intend to measure these parameters in the future to ensure the truthfulness of the use of colors. Other studies need to be done in different scenarios to test whether the TACS classification proposed by the World Society of Emergency Surgeries is superior to the routinely used subjective classifications.

R E S U M O

Objetivo: *avaliar a aplicabilidade do sistema de classificação de cores "Timing of Acute Care Surgery" (TACS) em um hospital público terciário de um país em desenvolvimento.* **Métodos:** *estudo longitudinal, retrospectivo, de um único centro, de março a agosto de 2016 e o mesmo período em 2017. Optou-se pela seleção de quatro especialidades cirúrgicas com alta demanda de urgências, as quais foram previamente treinadas sobre o sistema TACS. Para comparação com as classificações prévias de urgência e emergência, emergências foram consideradas como vermelhas e laranjas e urgências como amarelas, com intervalo de tempo ideal para cirurgia de uma hora e de seis horas, respectivamente.* **Resultados:** *os procedimentos não eletivos representaram 61% do número total de cirurgias. As classificações vermelha, laranja e amarela foram predominantes. Houve melhora significativa do tempo para a cirurgia na cor amarela após o sistema TACS. Períodos diurnos e noturnos influenciaram os resultados, com melhores resultados durante o período noturno.* **Conclusão:** *este é o primeiro estudo que usou o sistema TACS no dia a dia de um centro cirúrgico, e demonstrou que o sistema TACS melhorou o tempo de atendimento das cirurgias classificadas como amarelas.*

Descritores: *Programas de Rastreamento. Sistemas de Informação em Salas Cirúrgicas. Centro Cirúrgico Hospitalar.*

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