Relationship between risk stratification, mortality and length of stay in a Emergency Hospital

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Relationship between risk stratification in emergency medical services, mortality and hospital length of stay

Objective. To evaluate the relationship between risk stratification, mortality and hospital length of stay in emergency medical services. **Methodology.** A prospective cohort study that used the information in the ALERTÒ database of the HOSPUB to know the evolution of patients classified by nurses using the Manchester Risk Classification Triage System in the emergency medical services**,** of the Belo Horizonte Municipal Hospital - MG, Brazil. **Results.** 147,167 patients were analyzed, 5.9% were female. The most common risk classification was yellow (47.4%), followed by green (36.5%), orange (14.2%), blue (1.3%) and red (0.6%). The mean length of stay was less than one day in 95.4% of patients who were discharged from the hospital. Thirty percent of the patients classified as red, 2% of those classified as orange, and 0.3% of those classified as yellow died. There was direct a relationship between the severity of patient classification and the length of hospital stay. **Conclusion.** The risk classification system used by nurses in the hospital was a good predictor of death and hospital length of stay for patients admitted to the emergency medical services

Key words: triage; clinical evolution; nursing; emergency medical services.

Relación entre la estratificación del riesgo, la mortalidad y el tiempo de permanencia en un servicio de Urgencias

Objetivo. Evaluar la relación entre la estratificación del riesgo en el servicio de Urgencias, la mortalidad y el tiempo de permanencia hospitalaria. **Metodología.** Estudio descriptivo retrospectivo en el cual se utilizó la información de la base de datos ALERTÒ el HOSPUB para conocer la evolución de los pacientes clasificados por los enfermeros con el Sistema de Triage de Manchester de Clasificación del Riesgo del Servicio de Urgencias del Hospital Municipal de Belo Horizonte - MG, Brasil. **Resultados.** Se analizaron 147 167 pacientes, el (55.9%) de sexo femenino. La clasificación del riesgo más frecuente fue la amarilla (47.4%),

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seguida por la verde" (36.5%), la naranja (14.2%), la azul (1.3%) y la roja (0.6%). La media de permanencia en el servicio fue menor a un día, el 95.4% de los pacientes fue dado de alta del hospital. El (30%) de los pacientes clasificados en rojo, el (2%) de los naranja y el (0.3%) de los amarillo, fallecieron. Se verificó la relación directa entre la gravedad del paciente en la clasificación y el tiempo de permanencia hospitalaria. **Conclusión.** El sistema de clasificación del riesgo empleado por las enfermeras en este hospital fue un buen predictor de muerte y permanencia en el hospital de los pacientes que ingresaron al servicio de urgencias.

Palabras clave: triaje; evolución clínica; enfermería; servicios médicos de urgencia.

Relação entre estratificação de risco, mortalidade e tempo de permanência em um hospital de urgência

Objetivo: avaliar a relação entre a estratificação pela classificação de risco, mortalidade e permanência hospitalar em um Hospital de Urgência. **Metodologia:** Estudo de coorte prospectivo o qual foi utilizado o banco de dados ALERT® e HOSPUB para conhecer a evolução dos pacientes classificados pelos enfermeiros através do Sistema de Triagem de Manchester de Classificação de Risco de um Hospital Municipal de Belo Horizonte – MG, Brasil. **Resultados:** Foram atendidos 147 167 pacientes, destes (55.9%) foram do sexo feminino. A classificação de risco mais frequente foi a amarela (47.4%), seguida da verde (36.5%), da laranja (14.2%), azul (1.3%) e a vermelha (0.6%). A média de permanência no serviço foi menor que um dia e 95.4% dos pacientes receberam alta hospitalar. Os (30%) dos pacientes classificados como vermelho, (2%) dos laranjas e (0.3%) dos amarelos morreram. Verificou-se relação direta entre a gravidade da classificação dos pacientes e o tempo de permanência hospitalar. **Conclusão:** O sistema de classificação de risco utilizado pelos enfermeiros deste hospital, foi um bom indicador para o risco de óbito e permanência hospitalar dos pacientes que foram admitidos nos serviço de urgência.

Palavras chave: triagem; evolução clínica; enfermagem; serviços médicos de emergência.

Introduction

The high demand for health care services, and the insufficient structure of the health network, are factors that have contributed decisively to the burden on urgent and emergency services, transforming them into one of the most problematic areas in health care in the Unified Health System (SUS) in Brazil.[1] Large patient lines are common in these areas, where people vie for attention by order of arrival and not by degree of risks or suffering. This results in the worsening of the health status of some clients waiting in line, with death sometimes occurring due to lack of timely care.[2] The State Department of Health of Minas Gerais (SES-MG), starting in 2007, began to adopt the process of using the computerized *Manchester Triage System* (MTS) of risk classification, with its use facilitated through the Brazilian Group of Risk Classification.[3] The MTS work methodology was implemented in 1997 in Manchester, England, and has been widely distributed within the United Kingdom, and in other countries such as the Netherlands, Sweden, and Portugal, among others.[4]

Using the MTS, the initial complaint can be identified, which is then followed by the respective decision-making flowchart. The system presents 52 flowcharts with diverse clinical situations, and with several possible questions called "discriminators". These may be specific to a particular situation, or the cause of a problem, or may constitute various aspects that determine a general characteristic of the clinical condition. After identifying the discriminator,

the priority for clinical care is determined, along with the maximum acceptable waiting time. The MTS classifies patients into five priorities: red (emergent care), orange (very urgent), yellow (urgent), green (slightly urgent) and blue (not urgent).[4] Several international studies have been performed in order to evaluate the MTS. The MTS was evaluated in 13 554 pediatric patients treated in two Emergency Unit in the Netherlands, with the objective of analyzing its validity. The study showed that the MTS presented moderate validity for the classification of pediatric patients.[5-7] A study conducted in the ED of two hospitals in the Netherlands, to assess the validity and reliability of the MTS, analyzed the classification of 50 patients and identified high specificity, however little sensitivity to risk stratification of patients, as is claimed by the MTS.[6] Another study was conducted in Portugal, to determine whether patient subgroups created in the ED by applying the MTS presented different clinical outcomes, such as death or hospital admission, starting from the time of triage. It was concluded that the MTS was a powerful tool for differentiating patients who had high and low risk of precocious death, and that it was also capable of differentiating patients who would be admitted for at least 24 hours from those who would be discharged home.[7]

In Brazil, the MTS has also been studied. Research has shown that the system has been well adapted to the Brazilian reality, but that validation studies are needed because it is new technology in the implementation phase within the country.[8] Another Brazilian study established the predictive validity of the MTS deployed at the entrance door of an urgent service in Belo Horizonte, MG. This study also utilized the *Therapeutic Intervention Scoring System - 28* (TISS - 28) to measure the severity of patients after 24 hours of admission to the ED. The results showed that the protocol, in addition to organizing the flow of patient care, was able to predict patient evolution. However, for purposes of analysis, patients were excluded who were classified as the colors green and blue, as well as those who spent less than 24 hours in the ED.[9]

Given the results of previous studies in the area, and the importance being paid to the utilization of MTS as an instrument to reorganize the ED, the necessity of conducting further studies that can contribute to the improvement and utilization of the system within the Brazilian reality is recognized. Therefore, in addition to prioritizing the care for patients with clinical problems that appear as truly urgent, we questioned whether the MTS was capable of predicting a favorable outcome for those patients initially classified, and if they could be associated with favorable or unfavorable clinical outcomes, such as discharge, death, transfer, and length of hospital stay. Brazilian studies to evaluate the MTS are still rare, despite the fact that the utilization of the instrument for risk classification is increasing in health services within the country. Furthermore, it is observed that the SES-MG has placed great importance on, and expended much effort in training, implementation and utilization of the instrument.

It is known that nurses have been the most appropriate professionals to perform this activity in many countries, especially England, Canada, Australia and Portugal, because they can perform the proposal of Risk Classification, which is not identifying a medical diagnosis, but signs that enable establishing the level of clinical priority for care and the maximum waiting time recomended.[10] This fact justifies the performance of the present study, especially performed to evaluate the applicability of this system in the daily life of an emergency service, because it is a new field for nursing in Brazil, given the great importance that this activity has gained for nurses. To evaluate the relationship between risk stratification, mortality and hospital length of stay in emergency medical services.

Methodology

Type of study and setting. This was a prospective cohort study, in which we used the ALERT ® and HOSPUB databases at the Odilon Behrens

Municipal Hospital (HMOB), Belo Horizonte – MG. The color of risk classification assigned to patients was identified on admission to the emergency department, along with the outcome of the patient in the hospital up until time of discharge, hospitalization, transfer or death. The study was conducted at the Odilon Behrens Municipal Hospital, which is one of the main ports of entry for emergency care clinics in the state capital, and is also considered a reference site for the care of patients with high-risk pregnancies.

Population and sample. The study population consisted of all patients seen in the ED of HMOB (n = 154 396) during the period of January 1 to December 31, 2010. Of these patients, 17 337 required hospitalization. Of the remaining 137 059 patients who were not hospitalized, their length of stay was considered to be less than one day, since a 24-hour stay is the criterion for admission. In addition to the five classification colors of the MTS, there is also the color "white" (used in case of returning patients) and the category "Not Applicable" (used when, for some reason, there was no classification, or there was a "system error"). Both of these category types were excluded from the study, with the total sample size being 5 413 patients. We also excluded errors in the registration of patients in the ALERT ® system from the study, due to the inability to identify that it was the same patient registered at the time of admission into the HOSPUB system, totaling a loss of 1 816 patients. However, this loss did not cause bias in the sample, if one considers the probability of registration error for patients assigned to each color of the risk classification. Thus, after removing the exclusions, the ALERT® and HOSPUB databases were merged, and the sample was considered to be representative of the population. The final sample consisted of a total of 147 167 patients.

Data collection. The data regarding the date of service, color classification (red, orange, yellow, green and blue, in descending order of urgency / priority of care) and the discharge reason were extracted from the ALERT ® software, the system in use in the hospital ED, and that had the module of the MTS risk classification. Of the patients who were admitted to the hospital, the final outcome was extracted from the HOSPUB database system, which was used for registration of inpatients and allowed the calculation of length of stay from the clinical outcome of patients in the institution.

Treatment and data analysis. For data analysis, comparisons between the groups of the Manchester Triage System (MTS**)** colors were performed. The five classification categories were compared in relation to the blue category, in order to assess whether there were differences in the outcomes of patients in the urgent categories compared to the non-urgent category. The relative risk (RR) and the chi-square test were used for the analyses between outcomes: death, hospital discharge, discharge against medical advice, transfer to other services, and the MTS classification result. To test the hypothesis of independence and dependence between the variables, we used an appropriate method for calculating the confidence interval (CI) and the RR. For the comparison between the length of hospital stay of the patients and their respective color groups, we used the Mann-Whitney test.[12] We also tested the association among the MTS classification category and hospital admission. In this study, we considered a patient to be admitted when the length of stay in hospital was longer than 24 hours. Thus, the length of hospital stay was categorized as up to 24 hours, and more than 24 hours.

Ethical Aspects. This study met all the standards set out in the Brazilian Resolution 196/96 for research involving Human Subjects of the National Health Council. It was submitted to the Committee on Ethics and Research of the HMOB, and was approved (ETIC Opinion N. 0007.0.216.000-11).

Results

Among the patients studied (147 167), 82 414 (55.9%) were female. The mean age was 32 years, with a standard deviation of 21 years; the

range was a minimum of zero to a maximum of 110 years. The most frequent risk classifications included the color "yellow" (69 757 - 47.4%), followed by "green" (53 716 - 36.5%) and "orange" (20 898 - 14.2%); the colors "blue" (1 913 - 1.3%) and "red" (883 - 0.6%) had lower frequencies. With regard to the outcome in relation to care of patients, the majority (140 397 - 95.4%) of patients were discharged; 3 974 (2.7%) were discharged against medical advice; 2 060 (1.4%) were transferred to other health units; and, 736 (0.5%) died.

In terms of the length of stay, 137 307 (93.3%) were in hospital less than one day; 4 121 (2.8%) were hospitalized one to three days; 3 532 (2.4%), four to ten days; 1 324 (0.9%), 11 to 20 days; 883 (0.6%), over 20 days, with the maximum length of stay being 307 days. We performed the analysis of the MTS classification colors, with respect to the outcome that the patient obtained after treatment, taking into consideration that the outcomes being considered were: discharge, transfer, death or discharge against medical advice (Figure 1). It was found that 530 (60%) patients classified as red were discharged and 265 (30%) died (Table 1).

The risk of the patients in each color of the risk classification was obtained to determine the Relative Risk (RR) calculation. The analysis was performed for every color in relationship to the blue category. It can be observed that the greater the patient's priority, the greater the risk of progressing to death, according to Table 2.

Table 1. Distribution of the frequency of care in relation to outcome and risk classification, Belo Horizonte, MG, Brazil, 2010

Outcome / Classification	Discharged		Transfer		Death		Discharge against medical advice	
	n	%	n	%	n	%	n	%
Red	530	60.0	45	5.0	265	30.0	43	4.0
Orange	19 017	91.0	836	4.0	418	2.0	627	3.0
Yellow	66 757	95.7	698	1.0	209	0.3	2 093	3.0
Green	52 642	98.0	107	0.2	0	0.0	967	1.8
Blue	1 893	99.0	0	0.0	0	0.0	20	1.0

Table 2. Risk of progressing to death among patient groups by colors of the classification according to the MTS, Belo Horizonte, MG, Brazil, 2010

Risk classification	Relative Risk	*p*-value
Red	31.2	<0.001
Orange	13.3	
Yellow	6.7	
Green	1.0	
Blue	1.0	

There was a statistically significant difference between all groups of patients according to the colors in relation to length of hospital stay. Thus, the higher the priority for patient care, the longer patients remained in the hospital, as shown in Table 3.

Regarding admission to the hospital (hospitalization) of patients, according to the colors in the classification, it was found that the greater the urgency of care according to the classification, the higher the probability that the patient would be hospitalized, as presented in Table 4.

Table 3. Analysis of the length of stay of patients in relation to risk classification groups of the MTS colors, Belo Horizonte, MG, Brazil, 2010

Risk classification	Mean time (days)	*p*-value
Red	7.23	<0.001
Orange	1.74	
Yellow	0.560	
Green	0.110	
Blue	0.0020	

Table 4. Analysis of the Relative Risk of hospital admission (hospitalization) for each color of the MTS risk classification, compared to the blue classification, Belo Horizonte, MG, Brazil, 2010

Risk classification	Relative risk*	*p*-value
Red	33.8	<0.001
Orange	32	
Yellow	28.9	
Green	24.4	
Blue	1	

Discussion

Among patients who comprised the sample, the majority were female (56%), a result that differs from other studies where the majority were male.[6,9] However it should be noted that the study hospital was a reference center for high-risk pregnancies, a factor that may have influenced this result. The mean age of the patients was 32 years. This mean value was similar to a study in Brazil[8] which found a mean age of 39 years. This mean value is different from that found in other studies, in which younger mean ages prevailed (23.6 years[6] and 57.2 years).[9]

As for the risk classification, the most frequent priority were patients classified as yellow, followed by green. The less frequent priorities were blue and red, which were also found in a study in Portugal.[7]

Most patients (95.4%) were discharged, which can be partly explained by the patients classified as green and blue, priorities considered less urgent and not urgent, respectively, who are looking for care although they do not require hospitalization, because they have less severe medical conditions. These patients were discharged with referral to other health units, which is agreed to through the municipal health services network. For the outcome of hospital stay, 93.3% of patients spent less than a day in the hospital, data that were in accordance with the patients' outcome (discharge). The higher the clinical priority established in the classification, the longer the patient remained on the unit. A minority were hospitalized for up to 307 days. It should be noted that hospital stay has not been investigated in other studies.[5-9]

With regard to the outcome related to risk classification, the patients classified as red were the most differentiated from the others, especially regarding discharge and death. The more urgent the risk classification, the greater the chances of discharge and the lower the proportion of deaths. These data corroborate results from other studies.[6,7] The referral and counter-referral system is incorporated in the institution. The referral rates of the various classification colors were associated; the more urgent the care, the more likely it is that the patient is transferred, because he is registered in only one of the beds in the center of the city.

Regarding the rate of discharge against medical advice, at the hospital where the study was performed, patients classified as blue and green were discharged with referral to some external health unit. Therefore, lower rates of discharge against medical advice were identified in these color groups in relation to others. By comparing the risk of the patient progressing to death in each classification category, a big difference was found between the groups. The risk of death in patients classified as red is 31.2-fold the risk of the blue color category; the risk of death in patients classified as orange was 13.3-fold relative to the blue, and the risk of death in patients classified as yellow was 6.7-fold compared to the blue. These data are similar to that found in a study in the Netherlands, in which patients classified into categories considered most urgent were at higher risk of death.[6] Another study in Portugal also found that the higher the priority, the higher the risk of death.[7]

As for admission (hospital), the patients classified as red had a 33.8-fold higher risk of being hospitalized compared to the blue. Patients classified as orange had a 32-fold higher risk compared to the blue. The patients classified as yellow had a 28.9-fold higher risk compared to the blue and the patients classified as green had a 24.4-fold higher risk of being admitted to hospital in relation to the blue. These data were similar to those found in a study in the Netherlands in which the group of highest priority had a higher risk of being admitted (hospitalized) compared to the lower priority group.[6]

As a limitation, it is important to mention that this study used databases to obtain information; errors in the registry should be considered.

The findings bring additional information to the work conducted so far, since it measured the length of stay of hospitalized patients in the unit for all colors of the Risk Classification.

With regard to death, the study highlights the great difference found between patients classified as red compared to those classified as other colors. It was found that patients classified as higher priority demand greater nursing attention, planning and care. As for the hospital stay, patients classified as red and orange should be highlighted. These patients need more resources during their progression in the hospital. Finally, it was found that the MTS was a good predictor for the risk of death, hospitalization and length of hospital stay of patients. Patient groups with higher care priority had increased risk of death and remained longer in the unit. Thus, the use of the MTS by nurses can provide better performance and safety for the qualified classification of users who are admitted to emergency medical services.

In addition, the results of this study show that the MTS can be useful as a management tool, because it makes it possible to identify patients who need faster care, in addition to collaborating in the recognition of patients who have a higher risk of death, and who have clinical progression with complications. From these results, it is possible to create strategies that benefit patients upon their arrival for health care services. Further studies should be performed, taking into account the different care settings for application, evaluation and validation of the MTS.

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