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# Predictive value of the Manchester Triage System: evaluation of patients' clinical outcomes

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**ABSTRACT**

**Objective:** to analyze the predictive value of the Manchester Triage System in relation to clinical outcome of patients. **Methods:** prospective observational study of 577 patients admitted to the ER and subjected to risk classification. The Therapeutic Intervention Scoring System-28 (TISS-28) was used to measure the severity of patients (primary outcome) and secondary outcomes: high / transfer, death, and length of hospital stay. Descriptive and univariate analyzes were conducted. **Results:** patients classified as red are 10.7 times more likely to have scores above 14 in TISS-28 in relation to others. Patients classified as red have 5.9 times more chance of progression to death compared to others. Patients of high priority service are 1.5 times more likely to be hospitalized over five days than low priority. **Conclusion:** STM proved a good predictor of clinical outcomes.
**Key words**: Nursing; Emergency Medical Services; Triage; Clinical Evolution.

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## INTRODUCTION

Triages carried out in emergency services without the use of protocols were made intuitively until recently and without using a specific methodology. Thus, they were not replicable to other health professionals and did not serve as a parameter for audits[1].

From 2008, in order to standardize emergency care in the State of Minas Gerais, the state government has standardized the implementation of risk classification using the Manchester Triage System (MTS) in all state emergency units[2]. Since then, public hospitals of Minas Gerais have sought to develop strategies for the implementation of this risk assessment tool for users seeking emergency care in public institutions.

MTS was developed in the city of Manchester, England, in 1994 by a group of professionals specialized in triage. After identifying the main complaint of the user by the nurse, they developed a specific flowchart driven by discriminators which are presented as questions[3-4]. MTS presents 52 different flowcharts and a risk scale. This scale has five categories identified by number, name, color, and target time to the initial medical evaluation. According to the protocol, the individual can be coded in five colors: red (immediate care); orange (very urgent care); yellow (urgent care); green (standard care) and blue (non-urgent care)[4-6].

MTS includes severity criteria in an objective and systematic manner; it defines the clinical priority and the recommended time of patient care, from entering the unit until medical attention. This does not indicate medical diagnosis, but the identification of the main complaint[1].

In Brazil, some questions emerged after the implementation of MTS at the front doors of the emergency services, such as the decision to use this protocol without instrument validation, which can cause serious problems in the use of non-validated instruments that are not culturally adapted to our reality[7-8].

Added to this fact, some Brazilian hospitals have manual system for recording information. This system has flaws in measure, which allows duplication of efforts such as admission of patients by two different ordinances, loss of registration instrument or delay in location, illegible handwriting, incomplete data, hindering the flow of information between health professionals.

Studies to evaluate the prediction of risk classification protocols are still scarce in Brazil, which is why a study that validates all MTS priority levels for application in emergency services with manually registration is important. It is understood as classification predictor "how much it can be supported by the clinical prognostic of the patient, or even how much of the given code to the patient at admission in the service can confirmed by the prognostic, while in the emergency service"[9].

The objective of this study was to analyze the predictive value of the Manchester Triage System in relation to the clinical prognostic of patients of a hospital.

## METHODS

This is a prospective observational study to analyze the validity of risk prediction in manually classification. The study was conducted in the emergency department (ED) of the *Santa Casa de Caridade* of Diamantina - MG, reference to the extended health region of Jequitinhonha hospital medical assistance of medium and high complexity, becoming the main city's gateway to the urgent care clinics, besides being reference for other ED units in the region.

The study was approved by the Research Ethics Committee at the UFMG under the protocol CAAE - 0430.0.203.000-11.

The study population consisted of all patients who were admitted to Diamantina ED and remained in hospital for more than 24 hours.

For sample size calculation, we used 95% confidence level, maximum error of 5% and a rate of interest of 47%[10], reaching a sample of 370 patients. We added 20% to this value, totaling 444 participants, due to possible losses.

The study included patients admitted to the ER who went through the coding process and had medical charts with the identification of the nurse professional who performed the service, the description of the evaluation and the level of risk classification assigned.

Patients referred to another hospital and discharged or who died before 24 hours of data collection were excluded. We also excluded those under 18 years old.

Data collection began on May 19th and ended on September 20th, 2012, a total sample of 577 patients.

For data collection a semi-structured questionnaire with information regarding the MTS was used. To measure the severity of patients (primary outcome) the Therapeutic Intervention Scoring System - 28 (TISS-28) was used. The TISS-28 is applied retrospectively in order to use the information obtained in the last 24 hours of the patient's length of stay in the service. During the study, an instrument that had been built to assess the severity of patients in ED was not identified in the literature. We chose to use the TISS-28 because this is a translated and validated instrument in Brazil[11] used by other studies that used patients classification in other hospital departments[7].

Data from clinical outcome (discharge/referral and death) and hospital length of stay (secondary outcome) were obtained through search in the information system of the Hospital Management System, SPDATA.

It was considered as exposure variable the classification from MTS to the user in the admission, and the coding considered by the colors red, orange, yellow, green, blue and white. In the analyzes, the term "high priority" was used for the colors red and orange and "low priority" for yellow, green and blue[3-4]. In this study, only one person was classified in blue. We decided to keep this classification for analysis and add white color.

Data were entered and statistically analyzed using the Statistical Package for Social Sciences (SPSS), version 17.0. Double data entry was performed. To analyze the characteristics of patients, descriptive statistics and inferential analysis frequencies were used. The association between qualitative variables was performed using the chi-square test. The relationship between the average points of TISS-28 and the length of hospital stay in each classification group was verified by Kruskal-Wallis test. The significance level adopted was $p \leq 0.05$. Thereafter

Mann-Whitney test was performed. Bonferroni's correction was used ($p<0.01$). To measure the strength of association between exposure and outcome we calculated the odds ratio (OR), 95% confidence interval and p value. It was considered as exposure variable MTS categories and as outcome the dichotomy of the TISS-28 cutoff point, discharge/referral and death, dichotomy of the cutoff length of hospital stay. For TISS-28 data and length of hospital stay the median was used, which corresponds to percentile 50. To control confounding variables, logistic regression was performed.

**Table 1** - Statistical analysis by multiple comparisons of TISS-28 categories in the coding groups, Diamantina, MG, Brazil, 2012

| Coding Groups | TISS-28 | | | Comparison group | p value* |
|---|---|---|---|---|---|
| | Median | 95% IC | Min-Max | | |
| Red | 31.00 | [23.53-32.28] | 9-45 | Orange | **<0.001** |
| | | | | Yellow | **<0.001** |
| | | | | Green | **<0.001** |
| | | | | White | **<0.001** |
| Orange | 15.50 | [16.11-18.20] | 8-47 | Yellow | **<0.001** |
| | | | | Green | **<0.001** |
| | | | | White | **<0.001** |
| Yellow | 14.00 | [14.06-15.53] | 7-50 | Green | 0.153 |
| | | | | White | **<0.001** |
| Green/Blue | 13.00 | [12.35-14.78] | 7-34 | White | 0.037 |

*Source: Research data.*

*Note: *P calculated by Mann Whitney test adjusted by Bonferroni for p<0,01. Kuskal Wallis test, p<0,001.*

*Note: TISS-28 - Therapeutic Intervention Scoring System-28.*

## RESULTS

Out of the 577 patients classified, 242 (41.9%) were female and 335 (58.1%) were male. Minimum age of patients was 18 years old and the maximum 102 years old, mean 58.69 years.

Patients were coded with the colors red (21 - 3.6%), orange (158 to 27.4%), yellow (267-46.3%), green (62-10.7%), blue (1-0.2%), and white (68-11.8%).

Regarding the severity of patients, we found 468 (81.1%) patients coded as class I (physiologically stable patients requiring prophylactic observation), 95 (16.5%) in class II (physiologically stable patients, but requiring intensive care nursing and continuous monitoring) and 14 (2.4%) in class III (severe and hemodynamically unstable patients). There was statistical significance differences between classes by TISS-28 and the risk classification of the groups ($p<0.001$). In this study, there were no patients in Class IV of severity.

The mean score in TISS-28 found in patients coded as red was 27.90 points, orange 17.15 points, yellow 14.79 points, green 13.56 points and white 12.28 points.

We found significant statistical difference among the groups in relation to the score obtained in the TISS-28 (Table 1). There was no significance at the intersection of patients classified in yellow with green and green with white.

It is observed that patients code as red had higher scores than in other colors. Thus, this category was identified by TISS-28 as most severe from the clinical point of view than the other categories. The same observation can be made regarding the category orange to yellow and yellow to green.

The median score of TISS-28 showed the cutoff point 14 being possible to predict that the greater the patient's clinical priority, according to the MTS, the greater the number of points obtained in TISS-28 and, consequently, the more severe is the patient.

The length of hospital stay is a fact that was used as an outcome measure for the predictive value of the MTS. It was observed that the higher the clinical priority of the patient, the higher is the length of hospital stay. The average length of hospital stay decreased in the same order of patients' complexity: red, orange, yellow, green. Overall, patients were hospitalized on average for 7.3 days, with a minimum stay of 1 day and maximum of 64 days.

Analysis for multiple comparisons was conducted for hospital stay among all color groups (Table 2) we found a significant difference between patients classified according to risk in red and white, orange and white, yellow and white, green and white

Regarding the secondary outcome discharge/referral or death among patients treated at the hospital, 83.5% were discharged. Proportionally there were more deaths among patients who were coded as high priority: 42.8% red, 17.0% orange and 8.9% yellow. In patients coded in green, 9.6% progressed to death, and 7.3% from the white group also had the same outcome. From the referred patients, 79.1% were coded as orange and yellow. A statistical difference between clinical outcome and risk classification groups was found (Table 3).

Univariate analysis showed significant data on primary and secondary outcomes, according to Table 4.

There is statistical difference between the risk classifications of the groups regarding scores above 14 in TISS-28. Patients coded in red have 10.7 times greater chances of having a score above 14 points in TISS-28 than in the other colors. Patients considered as high priority of service have 3.1 times higher chances of having a score above 14 points in TISS-28 than patients who were considered as low priority.

The median of length of hospital stay indicated a cutoff point of 5 days. Univariate analysis showed a statistical difference between the color of risk classification groups orange and the high clinical priority of the length of stay for more than 5 days.

Patients of high priority are 1.5 times more likely to stay in hospital longer than 5 days than the low clinical priority.

**Table 2 -** Statistical analysis by multiple comparisons of hospital stay between the risk classification groups, Diamantina, MG, Brazil, 2012

| Coding groups | Length of hospital stay | | | | Comparison Group | p value* |
|---|---|---|---|---|---|---|
| | Mean | Median | 95% CI | Min-Max | | |
| Red | 10.6 | 8.00 | [5.9 – 15.2] | 2-41 | Orange | 0.560 |
| | | | | | Yellow | 0.195 |
| | | | | | Green | 0.190 |
| | | | | | White | **0.006** |
| Orange | 8.59 | 5.00 | [7.1 – 10.0] | 1-64 | Yellow | 0.044 |
| | | | | | Green | 0.102 |
| | | | | | White | **<0.001** |
| Yellow | 6.95 | 5.00 | [6.13 -7.76] | 1 – 60 | Green | 0.726 |
| | | | | | White | **0.001** |
| Green/Blue | 6.97 | 5.00 | [5.0-8.8] | 1 – 43 | White | **0.011** |
| White | 4.93 | 3.00 | [3.8-6.0] | 1 – 23 | - | **-** |

*Source: Research data.*

*Note: *p calculated by Mann Whitney test adjusted by Bonferroni for p<0,01. Kuskal Wallis test, p=0,038.*

**Table 3 -** Stratification of clinical outcomes between the risk classification groups. Diamantina. MG. Brazil. 2012

| Risk Classification | Outcome | | | | | | Total | | p value* |
|---|---|---|---|---|---|---|---|---|---|
| | Discharge | | Death | | Referral | | | | |
| | n | % | n | % | n | % | n | % | |
| Red | 12 | 2.1 | 9 | 1.5 | - | - | 21 | 3.6 | **<0.001** |
| Orange | 122 | 21.1 | 27 | 4.8 | 9 | 1.5 | 158 | 27.4 | |
| Yellow | 233 | 40.3 | 24 | 4.2 | 10 | 1.8 | 267 | 46.3 | |
| Green/Blue | 55 | 9.5 | 6 | 1.0 | 2 | 0.4 | 63 | 10.9 | |
| White | 60 | 10.5 | 5 | 0.8 | 3 | 0.5 | 68 | 11.8 | |
| All patients | 482 | 83.5 | 71 | 12.3 | 24 | 4.2 | 577 | 100 | |

*Source: Research data.*
*Note: *p calculated through chi-square test. significant if p≤0.05.*
*Note: Blue and green were grouped together because only one person was discharged.*

MTS proved to be a good predictor for the length of stay for more than 5 days, because patients with high clinical priority have more chances to stay in hospital when compared with low clinical priority patients.

As for the secondary outcome, univariate analysis showed a statistical difference between the risk classification of the groups in regard to death. There was no statically significance only between white and green.

It is possible to predict that the greater the severity of the patient, the greater the chances of progression to death, showing that the MTS can be a good predictor of death.

Patients coded as red have 5.9 times greater chances of progression to death when compared to those coded in other colors. Patients with high priority of service have 2.5 times greater chances of progression to death than patients classified as low priority.

## DISCUSSION

Regarding the characterization of the sample of the present study, most were males 58.1%. This data corroborated a study conducted in the emergency department of the State of Minas Gerais in which they found 57.3% of men[7].

The mean age of patients was 58.6 years, minimum 18 and maximum of 102 years old. Study conducted with patients who remained in the service after 24 hours found a mean age of 57.3 years old[7], near to the present study.

**Table 4 -** Univariate analysis for the variables of risk classification, with the outcome scores for TISS-28 >14, length of hospital stay >5 days and death, Diamantina, MG, Brazil, 2012

| Outcome | High Priority | Low Priority | Red | Orange | Yellow | Green/Blue | White |
|---|---|---|---|---|---|---|---|
| **TISS-28 >14** | | | | | | | |
| OR | 3.160 | 0.316 | 10.779 | 2.778 | 0.708 | 0.469 | 0.341 |
| 95% CI | 2.148-4.647 | 0.215-0.466 | 2.487-46.717 | 1.894-4.076 | 0.509-0.984 | 0.268-0.821 | 0.193-0.600 |
| p | <0.001 | <0.001 | 0.001 | <0.001 | 0.040 | 0.008 | <0.001 |
| **Length of hospital stay >5 days** | | | | | | | |
| OR | 1.504 | 0.665 | 1.985 | 1.457 | 0.842 | 0.907 | 0.614 |
| 95% CI | 1.041-2.172 | 0.460-0.960 | 0.823-4.789 | 1.007-2.108 | 0.603-1.176 | 0.528-1.557 | 0.356-1.057 |
| p | 0.030 | 0.030 | 0.127 | 0.046 | 0.313 | 0.723 | 0.079 |
| **Death** | | | | | | | |
| OR | 2.509 | 0.399 | 5.964 | 1.752 | 0.551 | 0.740 | 0.532 |
| 95% CI | 1.486-4.237 | 0.236-0.673 | 2.416-14.723 | 1.043-2.943 | 0.327-0.928 | 0.307-1.786 | 0.206-1.370 |
| p | 0.001 | 0.001 | <0.001 | 0.034 | 0.025 | 0.503 | 0.191 |

The mean age of patients in this study is higher compared to that found (mean 52.3 years) in patients on care admission[4]. This may be related to the fact that younger patients seeking care with less severe problems are treated and discharged in less than 24 hours.

In the same hospital of this research, a study conducted with medical charts of all patients who were admitted to ER, being coded as "red" (7-1.4%), "orange" (46-9.2% ), "yellow" (181-36.2%), "green" (235- 47.0%) and "blue" (from 31 to 6.2%)[12]. The data from this study showed that after 24 hours, this reality change, since the tendency is for patients classified as standard and non-urgent to no longer be in the hospital. Thus, after 24 hours, we found coded as "red" (21-3.6%), "orange" (158-27.4%), "yellow" (267- 46.3%), "green" (65-10.7%), "blue"(1-0.2%), "white"(68-11.6%). This can be justified because it is an hospital inserted in a context in which primary care is not structured to meet the cases of low complexity, so 53.2% of classification was standard (green) and non-urgent (blue). After 24 hours, we observed that only people with higher priority remained in hospital, and therefore there was a prevalence of people rated as yellow and orange.

It can be argued that patients with higher clinical priorities (red, orange and yellow) had higher scores on the TISS-28 indicating they were more physiologically compromised and therefore required more health care. The opposite can be said for those classified in green and white.

A statistically significant difference was found between the colors of the risk classification and the score obtained by the TISS-28. The data obtained are similar to one study found that applied TISS-28 in patients classified by the MTS[7], which validates the claim that the higher the score received in the TISS-28, the highest clinical priority in MTS.

In this study, the mean score of the TISS-28 received by patients coded in the red color was high, compared to studies in ICU hospitalized patients who found an average of 21.0 points[13] and 20.14[14] points in TISS-28. This may be related to the fact that the hospital where this study was conducted is a reference to the expanded health region and has only 10 ICU beds, prioritizing the most critical patients.

The length of hospital stay was also used in this research as one of the outcomes to measure MTS prediction. Data shows that more severe patients remain hospitalized longer when compared to lower clinical priority patients. Thus, the MTS is a good predictor of length of hospital stay for high clinical priority patients when compared to low clinical priority patients.

There was no statistical significance for the coding of patients in red color and the length of hospital stay greater than five days. This may have happened because of the patients coded as red died before 5 days, since death is higher in this group.

Patients of high priority of service have 1.5 times more chances to stay in hospital longer than 5 days than low clinical priority patients. We found only one study that identified no statistical difference between MTS groups, compared with the average length of hospital stay[9]. We suggest that further studies conduct researches in order to confirm the length of hospital stay relationship and MTS, since the studies found considered the time spent in the emergency room[3-5] and, this study considered the total time of the patient when admitted to the ER, until discharge/referral to another hospital or death.

Another indicator used in this study to measure the effectiveness of MTS is prediction of death. Patients coded in red died more than those who were coded in orange and yellow. The same analysis can be made for orange with respect to yellow. In this study, the percentage of people in green who died was slightly higher than yellow, but the univariate analysis showed no statistical association between those coded in green and other colors in regard to death. There was no statistical difference for white.

The presented data have shown that the MTS is a good predictor of death, that is, the higher the severity of the patient the greater the chances of progression to death. Patients coded in red have 6 times more chances to die. Patients classified as high clinical priority are 2.5 times more likely to die while in the low priority patients the chance is of 0.399. The data from this study confirm the findings of another study[9] that patients coded as red die more than those coded as orange and yellow and have 3.8 times greater chances of dying when compared to orange and 7.1 times higher compared to yellow. It was concluded that the prognostic of patients is different between the categories of MTS and, notably, the patients in the red group are more critically ill.

Death is associated with urgent MTS categories[6]. The prediction of Manchester in relation to death has also been described in another study, in which the risk of death in patients of higher priority was 5.58 times greater than the risk of death for low priority patients. The study adds that the risk of hospitalization in high priority was 4.86 times greater than the lowest priority[4].

International studies concluded that MTS proved to be a very powerful tool to distinguish the risk of death, need for hospitalization and use of diagnostic tests such as electrocardiogram and laboratory tests[3-4,15].

The percentage of deaths was small (1.9%) in patients classified as non-urgent (green and white). These deaths may be related to the fact that there is deterioration in patients' clinical condition during the 24 hours of hospitalization.

The results of this prospective observational study concerning the predictive analysis of the MTS in relation to the clinical prognostic of the users of a hospital in Minas Gerais using previously tested and validated instruments which are clinically relevant, similar to those found in national and international studies, being able to state that has external validity for the region of *Vale do Jequitinhonha-MG*.

A limitation factor of the study was the choice of the measurement instrument TISS-28, which selects patients who are in hospital from 24 to 48 hours. The choice of this instrument made difficult to compare with other studies of the area and allowed us to obtain different data, since critical ill patients may die within 24 hours, and less severe patients may already have been discharged.

## CONCLUSION

The present study found a majority of male patients (58.1%) with a mean age of 58.6 years old coded as yellow (46.5%).

The study data allow us to conclude that MTS showed to be a good predictor of clinical severity, since after applying

a severity scale between 24 to 48 hours, there was association of severity of the risk classification with those obtained by TISS-28. MTS proved to be a good predictor of length of hospital stay, since patients with high clinical priority remain in hospital longer than the low clinical priority ones. MTS was also a good predictor of discharge/referral and death, since patients classified by the MTS in the categories of clinical severity had more chances of death.

The MTS preconization in the State of Minas Gerais is a recent regulation from 2008, to validate its use in emergency rooms and recommend MTS use as a triage instrument for urgent and emergency units of all Brazilian states. Thus, the standardization of the language used in the risk classification in the country will be possible.

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