Central European Journal of Nursing and Midwifery

*Cent Eur J Nurs Midw* 2025;16(3):2264–2270
doi: 10.15452/CEJNM.2025.16.0019

**ORIGINAL PAPER**

# Outcomes of the triage process in Croatian emergency departments: a retrospective study using the Australasian Triage Scale

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Received December 4, 2024; Accepted August 8, 2025. 

## Abstract

*Aim:* To evaluated the effectiveness of the Australasian Triage Scale (ATS) in Croatian emergency departments by analyzing hospitalization, mortality, and discharge rates across different triage categories. *Design:* A retrospective cohort study. *Methods:* A total of 68,165 adult patients treated in the emergency department of the Clinical Hospital Center, Rijeka between January 1 and December 31, 2023. Patients were triaged into Australasian Triage Scale levels 1 to 5, and their outcomes – including hospital admissions, discharges, and mortality – were analyzed. Statistical significance was assessed using chi-square tests for categorical variables, with Bonferroni-adjusted post-hoc pairwise comparisons. Age differences across categories were analyzed using ANOVA and Kruskal-Wallis tests. A p-value of $< 0.05$ was considered statistically significant. *Results:* Significant differences in outcomes were observed across all Australasian Triage Scale categories ($p < 0.001$). Category 1 patients had the highest mortality rate (74.6%) and the lowest hospitalization rate (4.6%), reflecting the critical nature of these cases. Category 2 showed a mortality rate of 17.7% and a hospitalization rate of 26.3%. Category 3, which accounted for 45% of the sample, had the highest hospitalization rate (48.4%) with a lower mortality rate (6.9%), indicating appropriate triage of serious but non-immediately life-threatening cases. Categories 4 and 5 exhibited low mortality (0.8% and 0%) and high discharge rates (88.6% and 89.9%), supporting the accurate identification of lower-acuity patients. Post-hoc comparisons confirmed significant differences in hospitalization and mortality between most Australasian Triage Scale levels ($p < 0.001$), except between categories 4 and 5, in which no statistically significant difference was found ($p = 0.169$). Median time to treatment corresponded to clinical urgency, ranging from 0 minutes in ATS 1 to 24 minutes in ATS 5, indicating timely initiation of care. *Conclusion:* The Australasian Triage Scale effectively stratifies patients based on clinical urgency, facilitating appropriate resource allocation and timely intervention. However, the high proportion of non-urgent visits contributes to emergency department overcrowding. These findings underscore the need for public education on appropriate use of emergency departments and stronger integration of primary healthcare services to enhance triage efficiency.

**Keywords:** Australasian Triage Scale, emergency department, overcrowding, patient outcomes, triage nurse.

## Introduction

Emergency medical care in hospital emergency departments poses increasing challenges to healthcare systems worldwide, as departments strive to provide timely interventions amidst rising patient demand. In the Republic of Croatia, emergency departments offer patients direct access to medical care without the need for prior referral allowing rapid response to acute health issues. However, this accessibility often results in the overuse of emergency services for non-urgent conditions, contributing to overcrowding extended waiting times, and reduced efficiency in identifying and treating critical cases (Hoot & Aronsky, 2008; Sartini et al., 2022; Trzeciak & Rivers, 2003).

To address these challenges, triage systems have been introduced to prioritize patient care based on clinical urgency rather than order of arrival. Triage protocols enable faster treatment of patients with severe conditions, support optimal allocation of medical resources, and reduce the risks associated with delayed care. Studies have demonstrated that effective and timely triage reduces complications in critically ill patients and improves the overall efficiency of emergency departments (Christian et al., 2008; Molyneux et al., 2006).

In Croatia, the triage system was introduced in 2012 under the guidance of the Croatian Institute

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of Emergency Medicine, with the first implementation taking place at the General Hospital "Dr. Tomislav Bardek" in Koprivnica. The system is based on the Australasian Triage Scale (ATS), which categorizes patients according to the urgency of their condition and defines maximum waiting times for initial medical assessment. This standardized approach ensures that patients are prioritized based on the severity of their clinical presentation, irrespective of the number of diagnostic procedures or resources required (Christ et al., 2010; Considine et al., 2004; Gerdtz & Bucknall, 2001).

Triage in Croatian emergency departments is performed by nurses trained according to the Emergency Triage Education Kit (ETEK) guidelines. Ideally, triage should be conducted by nurses with postgraduate training in emergency medicine. However, due to a shortage of such professionals, triage is often performed by nurses with a bachelor's degree and at least one year of emergency department experience, or by nurses / technicians with a minimum of three years' experience and who have completed triage training. Research suggests that medical personnel with extensive emergency department experience make more consistent triage assessments, ultimately contributing to improved patient outcomes (Gerdtz & Bucknall, 2000; Suamchaiyaphum et al., 2024; Zachariasse et al., 2019).

During triage, nurses assess urgency based on the patient's presenting complaint, medical history, and physiological parameters. Importantly, triage nurses do not make formal diagnoses but evaluate the urgency of care required to ensure timely treatment. The triage process typically takes about five minutes and is critical in preventing deterioration in seriously ill patients. If a patient's condition worsens while waiting, re-triage allows for prompt escalation of care (Yancey & O'Rourke, 2023).

Emergency department overcrowding is a global issue, not unique to Croatia. It is influenced by factors such as healthcare legislation, increased expectations for rapid diagnostics, and socioeconomic conditions. Patients often turn to emergency departments for non-urgent issues due to dissatisfaction with primary care or the perception of faster service (Darraj et al., 2023).

The introduction of triage systems seeks to mitigate the risks of delayed treatment for severe conditions and enhance the safety and efficiency of emergency care. By prioritizing patients based on clinical urgency, triage contributes to better management of limited healthcare resources and improves the identification and treatment of high-risk cases (Hinson et al., 2019; Mistry et al., 2018). Combined with ongoing staff education, the triage system plays a key role in improving both the speed and quality of emergency care delivery in Croatia.

## Aim

The aim of this study was to evaluate the effectiveness of the Australasian Triage Scale in the Croatian emergency care setting by examining how well it stratifies patients according to clinical urgency and how this impacts hospital admission, discharge, and mortality outcomes. Using a retrospective analysis of patient data from the hospital information system, this study examined how clinical outcomes such as hospitalization, discharge, and mortality vary across ATS categories, thereby reflecting the scale's role in clinical prioritization within emergency care.

## Methods

### *Design*

The study was conducted as a retrospective analysis of patients admitted to the emergency department of the Clinical Hospital Center, Rijeka between January 1, 2023, and December 31, 2023.

### *Sample*

The study population consisted of 68,165 adult patients, aged 18 years and older, who were categorized into one of five ATS levels at the time of emergency department admission. Pediatric patients were not included in the study, as the hospital has a separate pediatric emergency department, where children and adolescents under the age of 18 receive emergency care. Additionally, patients with incomplete medical records, including missing ATS classifications or outcome data, were excluded from the analysis. Cases that fell outside the defined study period were also removed to maintain a standardized dataset.

### *Data collection*

The data were obtained from the hospital information system, which records all patient visits, ATS classifications, hospital admissions, discharges, and mortality outcomes. To ensure data accuracy, automated system checks were performed to validate the completeness and consistency of the dataset before statistical analysis. The ATS is a structured five-level triage system designed to assess the urgency of medical intervention. Patients classified as ATS 1 (Immediate) require urgent, life-saving interventions, while those in ATS 2 (Emergency) are in conditions that could rapidly

 

become life-threatening and require immediate attention. ATS 3 (Urgent) patients are in serious but non-life-threatening conditions and require medical evaluation as soon as possible. ATS 4 (Semi-urgent) patients present with conditions that are not critical but require medical attention when feasible, and ATS 5 (Non-urgent) patients have minor conditions that can be safely delayed without immediate intervention. This classification allows for a standardized assessment of urgency and ensures that patients receive appropriate medical attention based on their condition. Compliance with ATS time targets was evaluated by comparing the actual time from triage to initial medical intervention against the maximum recommended response time for each ATS category. Patients were considered to have met the time target if care was initiated within the category-specific timeframe (e.g., 10 minutes for ATS 2, 30 minutes for ATS 3, etc.).

### *Data analysis*

Descriptive statistics were used to summarize the data, including frequency and percentage analyses for categorical variables. Nominal variables were presented using frequency distributions and percentages, while ordinal variables were analyzed using medians and interquartile ranges. The normality of continuous variables was assessed using the Kolmogorov-Smirnov test and the Shapiro-Wilk test. To evaluate differences between triage categories, the chi-square test was used for categorical variables. Post-hoc pairwise comparisons were performed using Bonferroni-corrected Z-tests for proportions to determine significant differences between specific ATS categories. Analysis of variance (ANOVA) was conducted to assess age differences across triage categories, and Kruskal-Wallis tests were used as a non-parametric alternative for skewed distributions. Statistical significance was set at $p < 0.05$, with all p-values reported as two-tailed. All statistical analyses were performed using Statistica software, version 14.0.1.25 (TIBCO Software Inc.).

## Results

In this study, data from 68,165 adult patients triaged in the emergency department of the Clinical Hospital Center, Rijeka were analyzed. Patients were classified into five categories according to the Australasian Triage Scale, reflecting different levels of clinical urgency. A detailed distribution of patient outcomes by triage category is presented in Table 1.

*Patient distribution by triage category*

*Category 1 (Immediate):*
This group comprised only 1.2% of patients (n = 813). Despite the small proportion, the mortality rate was extremely high (74.6%), indicating the critical condition of these patients upon arrival. Interestingly, only 4.6% were hospitalized, likely due to rapid deterioration or death before admission.

*Category 2 (Emergency):*
Representing 9.6% of patients (n = 6,523), this group had a mortality rate of 17.7% and a hospitalization rate of 26.3%. Although the mortality rate was lower than in Category 1, it remained clinically significant, confirming the need for urgent intervention in these cases.

*Category 3 (Urgent):*
The largest proportion of patients fell into this category (45.0%, n = 30,671). It had the highest hospitalization rate (48.4%), reflecting serious but not immediately life-threatening conditions. The mortality rate was 6.9%, suggesting the need for close monitoring and timely care.

*Category 4 (Semi-urgent):*
This group included 32.8% of patients (n = 22,315), with a low hospitalization rate of 10.6% and a mortality rate of only 0.8%. The majority of these patients were discharged, indicating generally stable clinical presentations.

*Category 5 (Non-urgent):*
Comprising 11.5% of patients (n = 7,810), this category showed the lowest severity, with no recorded deaths, a discharge rate of 89.9%, and a hospitalization rate of 10.1%. These results align with the expectations for ATS 5, confirming that most patients required minimal intervention.

**Table 1** Distribution of patient outcomes by ATS category (n = 68,165)

| Triage Category | Percentage of Patients (%) | Number of Patients (n) | Hospitalization Rate (%) | Discharge Rate (%) | Mortality Rate (%) |
|---|---|---|---|---|---|
| **1 Immediate** | 1.2 | 813 | 4.6 | 20.8 | 74.6 |
| **2 Emergency** | 9.6 | 6,523 | 26.3 | 56.0 | 17.7 |
| **3 Urgent** | 45.0 | 30,671 | 48.4 | 44.7 | 6.9 |
| **4 Semi-urgent** | 32.8 | 22,315 | 10.6 | 88.6 | 0.8 |
| **5 Non-urgent** | 11.5 | 7,810 | 10.1 | 89.9 | 0.0 |

*Statistical analysis: Chi-square test for triage categories*

Chi-square tests revealed statistically significant differences in hospitalization, discharge, and mortality rates across ATS categories ($p < 0.001$ for all comparisons). The results are summarized in Table 2.

**Table 2** Chi-square test results for outcome differences between the ATS categories

| Test | Chi-square Value | p-value |
|---|---|---|
| **Hospitalizations** | 10,893.49 | < 0.001 |
| **Discharges** | 14,089.66 | < 0.001 |
| **Mortality** | 10,043.37 | < 0.001 |

*Hospitalization rates*

Hospitalization rates differed significantly across ATS categories ($\chi^2 = 10{,}893.49$, $p < 0.001$). Post-hoc pairwise comparisons (Table 3) showed significant differences between most categories, with the most prominent contrast between ATS 1 and ATS 5.

*Discharge rates*

Discharge rates also showed statistically significant differences ($\chi^2 = 14{,}089.66$, $p < 0.001$), as shown in Table 2. Patients in ATS 4 and 5 were significantly more likely to be discharged compared to ATS 1 and 2. There was no significant difference in discharge rates between ATS 4 and ATS 5, confirming their clinical stability.

*Mortality rates*

Mortality differed significantly across ATS groups ($\chi^2 = 10{,}043.37$, $p < 0.001$), with the highest rate in ATS 1 (74.6%) and no deaths in ATS 5. As shown in Table 4, post-hoc analysis confirmed statistically significant differences in mortality between ATS 1 and all other categories ($p < 0.001$), and between ATS 2 and ATS 3.

**Table 3** Pairwise post hoc comparisons for hospitalization rates

| ATS Categories | p-value |
|---|---|
| **1 vs 2** | 0.0349 |
| **1 vs 3** | 0.7325 |
| **2 vs 3** | < 0.001 |

**Table 4** Pairwise post hoc comparisons for mortality rates

| ATS Categories | p-value |
|---|---|
| **1 vs 2** | < 0.001 |
| **1 vs 3** | < 0.001 |
| **2 vs 3** | < 0.001 |

*ATS stability across age groups*

Analysis of age distribution across ATS categories showed significant differences using both ANOVA ($F = 1130.81$, $p < 0.001$) and the Kruskal-Wallis test ($H = 4386.25$, $p < 0.001$). These results indicate that older patients were more frequently assigned to higher-severity ATS categories, suggesting a correlation between age and clinical urgency.

*Time to treatment by triage category*

An analysis of the time interval between triage and the initiation of medical care showed a consistent pattern aligned with the urgency levels defined by the Australasian Triage Scale. As presented in Table 5, patients in Category 1 were treated immediately (median: 0 minutes), while Category 2 patients began receiving care within a median of 5 minutes. Median time to treatment increased with decreasing clinical urgency, reaching 19 minutes for Category 3 and 28 minutes for Category 4. Patients in Category 5, representing non-urgent cases, were typically treated within 24 minutes. These findings confirm that emergency care was delivered in accordance with ATS-defined response time targets, ensuring timely treatment for patients based on clinical need.

**Table 5** Mean and median time from triage to initial treatment by ATS category

| Triage Category | Mean Waiting Time (min) | Median Waiting Time (min) |
|---|---|---|
| **1 Immediate** | 0.01 | 0 |
| **2 Emergency** | 7.4 | 5 |
| **3 Urgent** | 25.2 | 19 |
| **4 Semi-urgent** | 38.0 | 28 |
| **5 Non-urgent** | 30.1 | 24 |

## Discussion

The implementation of the Australian Triage Scale in Croatian emergency departments aimed to address the challenge of overcrowding in emergency departments and to ensure timely medical attention for critically ill patients. The ATS serves as a structured tool for risk stratification, prioritizing patients based on their urgency and enabling effective resource allocation. However, triage is not only an organizational necessity but also has direct implications for clinical outcomes, as a precise classification of patients ensures optimal care and reduces mortality risks (Doherty et al., 2003; Lin et al., 2024).

The results of this study confirmed that the ATS effectively differentiates patients by severity upon arrival at the emergency department. Statistically significant differences in hospitalization, discharge, and mortality rates across ATS categories ($p < 0.001$) indicate that the ATS reliably stratifies patients according to medical urgency. The high mortality rate in ATS Category 1 (74.6%) reflects the critical condition of these patients and highlights the need for immediate medical intervention. These findings are consistent with previous studies demonstrating that the ATS successfully prioritizes patients with life-threatening conditions, ensuring rapid medical attention to those most in need (Christ et al., 2010; Hinson et al., 2019).

Similarly, patients classified as ATS 2 had a mortality rate of 17.7% and a hospitalization rate of 26.3%, confirming that this category included patients who, while not in immediate life-threatening danger, still required urgent medical attention. The observed differences between ATS 1 and ATS 2 further support the accuracy of the ATS in distinguishing the severity of emergency cases and ensuring appropriate resource allocation. The largest patient group, ATS 3 (45% of the sample), had a high hospitalization rate (48.4%) but a lower mortality rate (6.9%), indicating that the ATS successfully identified patients requiring hospitalization without an immediate life-threatening condition. These findings align with those of Lin et al. (2024), who demonstrated that the ATS allows for effective risk categorization, ensuring prompt care for high-risk cases while reducing the burden on emergency services.

Conversely, the low mortality rates in ATS 4 and ATS 5 confirm that patients in these categories generally present with non-life-threatening conditions. The high discharge rate among these patients highlights the effectiveness of the ATS in distinguishing lower-acuity cases, ensuring that emergency resources remain focused on the most urgent cases. However, the significant proportion of emergency department visits in ATS Categories 4 and 5 suggests that many patients seek emergency care for non-urgent conditions, which may contribute to emergency department overcrowding and put a strain on hospital resources. This issue is not unique to Croatia but has been widely reported in international studies, in which large numbers of non-urgent ED visits led to longer waiting times and increased pressure on healthcare facilities (Ackroyd-Stolarz et al., 2011; Horwitz et al., 2010; Liew et al., 2003; Sprivulis et al., 2006). These findings emphasize the need for public education on appropriate emergency department utilization and improved integration of primary healthcare services to reduce the influx of non-urgent cases into emergency departments.

Despite the ATS being a standardized triage tool, variations in its application may occur due to differences in nurses' experience and training. Although this study did not include inter-rater reliability measures, such as Triage-weighted kappa, the use of clearly defined ATS criteria, standardized triage protocols, and trained personnel minimizes subjectivity and supports the consistency of categorization. The strong correlation between ATS categories and clinical outcomes further supports its validity in prioritizing emergency care.

Statistical analysis showed that older patients were more frequently categorized into higher severity triage categories, suggesting a possible association between age and clinical urgency, possibly due to age-related comorbidities or more complex clinical presentations.

The observed time to treatment is consistent with the response time thresholds set out in the Australasian Triage Scale (Australasian College for Emergency Medicine, 2013). Critically ill patients (ATS 1 and 2) received prompt medical attention, with median times of 0 and 5 minutes, respectively, reflecting adherence to emergency department protocols. The progressive increase in treatment time across triage categories illustrates the effective prioritization of care based on clinical urgency. In particular, patients in lower acuity categories (ATS 4 and 5) were still treated within the recommended timeframe, indicating overall efficiency in the emergency department. These results demonstrate the operational reliability of the triage system and underline the role of the ATS in ensuring timely and appropriate medical treatment.

 

### *Limitation of study*

Several limitations should be noted. This study was conducted in a single tertiary care hospital, which may limit the generalizability of the results to other facilities with different patient demographics, staffing models, or resource availability. Future studies should include multicenter analyses to evaluate the effectiveness of ATS in different healthcare settings.

In addition, this study focused exclusively on adult patients (≥ 18 years) since pediatric patients are treated in a separate emergency department. As the ATS has a pediatric-specific version, future research should evaluate its effectiveness in pediatric emergency triage to ensure its applicability in all age groups.

Another limitation is the lack of analysis of inter-rater reliability, which prevents an assessment of variability in triage classification between different nurses. Although clearly defined ATS criteria and standardized protocols were available, future studies should incorporate the triage-weighted kappa ratio or similar reliability metrics to determine the consistency of ATS use in emergency departments.

Finally, this study did not account for comorbidities, socioeconomic factors, or other potential confounders that could influence triage categorization and patient outcomes. Future research should consider multivariable regression models to better isolate the effects of ATS classification on hospitalization and mortality.

## Conclusion

This study confirms that the ATS is a valid and effective system for prioritizing emergency care based on clinical urgency. The scale successfully stratified patients by severity, with clear differences in hospitalization, discharge, and mortality rates. Timely care was achieved in line with ATS recommendations, demonstrating both clinical and operational reliability.

Despite these strengths, the high proportion of non-urgent visits highlights the need for public education and better primary care integration.

Further research should assess ATS performance in diverse settings, including pediatric care, and explore inter-rater reliability to enhance consistency in triage decisions.

## Ethical aspects and conflict of interest

The study was approved by the Ethics Committee of the Clinical Hospital Center, Rijeka (Approval No.: 003-05/24-01/79). Since this was a retrospective study based on anonymized hospital records, there was no requirement to obtain informed consent, as no direct patient contact or intervention was involved. All data were fully de-identified before analysis to ensure patient confidentiality. No personal identifiers, such as names or medical record numbers, were included in the dataset. Data were stored on a secure, password-protected system, accessible only to the research team. The study was conducted in accordance with ethical guidelines for retrospective clinical research and complied with relevant data protection regulations. The authors declare no potential conflicts of interest concerning the research, authorship, or publication of this article.

## Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sector.

## Author contributions

Conception and design (KI), data analysis and interpretation (KI, IN), manuscript draft (KI, IN), critical revision of the manuscript (KI, IN), final approval of the manuscript (KI).

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