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Triage nurse staffing: a study on the need for model improvements

Arian Zaboli,¹ Francesco Brigo,¹ Serena Sibilio,² Gloria Brigiari,³ Magdalena Massar,¹ Gabriele Magnarelli,^{4,5} Gianni Turcato⁶

¹Innovation, Research and Teaching Service (SABES-ASDAA), Teaching Hospital of the Paracelsus Medical Private University (PMU), Bolzano, Italy; ²Institute of Nursing Science, University of Basel, Basel, Switzerland; ³Unit of Biostatistics, Epidemiology and Public Health, Department of Cardiac, Thoracic, Vascular Sciences and Public Health, University of Padova, Padua, Italy; ⁴Emergency Department, Hospital of Merano-Meran (SABES-ASDAA), Merano-Meran, Italy; ⁵Lehrkrankenhaus der Paracelsus Medizinischen Privatuniversität, Salzburg, Austria; ⁶Department of Internal Medicine, Intermediate Care Unit, Hospital Alto Vicentino (AULSS-7), Santorso, Italy

Correspondence: Arian Zaboli, Innovation, Research and Teaching Service (SABES-ASDAA), Teaching Hospital of the Paracelsus Medical Private University (PMU), via A. Volta 13; Bolzano, Italy

E-mail: zaboliarian@gmail.com

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Ethics approval: the study was conducted in accordance with the guidelines of the local ethics committee (Ethics Committee for Clinical Research, South Tyrol Health Authority, Bolzano, Italy; approval number 28-2024) and adhered to the principles outlined in the Declaration of Helsinki for ethical medical research involving human subjects.

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Abstract

This study addresses the challenge of determining appropriate nurse staffing levels for triage in Emergency Departments (EDs). It evaluates whether existing nurse staffing models, typically designed for other hospital settings, can be effectively applied to triage. The research was conducted at Merano Hospital's ED from January 1, 2021, to November 30, 2022, and involved an analysis of data from patient triage assessments. The findings indicate that standard ward staffing models are not easily adaptable to the triage environment, underscoring the need for a more systematic approach to calculating triage nurse staffing. The current Italian ministerial guidelines do not account for the unique demands and complexities of the triage setting.

Introduction

Triage in Emergency Department (ED) settings plays a fundamental role in assessing all incoming patients to determine which ones can safely wait and which require prompt evaluation by ED physicians.¹ Despite the critical importance of triage, there remains uncertainty about how to determine the appropriate number of nurses needed to operate effectively in this context.

Recently, guidelines from the Italian Ministry of Health have specified the required number of nurses in triage based on the type of ED, rather than patient flow or workload.² These guidelines differ from those in other healthcare settings, where it is well established that maintaining a specific nurse-to-patient ratio is essential for effective patient management and to prevent nurse overload.²⁻⁴ It is widely recognized that lower nurse-to-patient ratios in wards are associated with an increased risk of negative patient outcomes.⁴⁻⁶ While the importance of maintaining an adequate nurse-to-patient ratio is well-established in other wards to ensure safe patient management and prevent nurse overload, this seems to be not applied in the context of triage. In hospital settings, the nurse-to-patient ratio not only determines the number of patients manageable in a department but also helps define the required number of nurses. This concept is so well established that both national and international guidelines recommend calculating nurse staffing levels on the nurse-to-patient ratio. However, this approach has never been applied to the ED.

In the context of triage, where nurses are continuously exposed to rapid and ongoing patient assessments. Recent studies have indicated that prolonged exposure of nurses in triage is linked to a higher risk of errors, yet the optimal number of nurses needed to manage triage in EDs based on patient flow remains unknown.^{2,7,8} Despite this evidence, the Italian ministry's guidelines do not take into account the number of patients accessing the ED or how to best organize ED triage nurse staffing. Instead, staffing levels are determined by the structural characteristics of the ED, an approach that seems inconsistent with established practices in other areas.² In hospital wards, regardless of the ward's size, patient volume, or the hospital's scale and significance, nurse staffing is determined by a stable nurse-to-patient ratio, a practice that is not applied in triage.

This highlights a significant gap between ministerial guidelines and standard hospital practice, revealing differing approaches due to the peculiarities of the ED compared to other hospital departments. The aim of this study was to evaluate the nursing workload in triage by applying the standard calculation methods used for determining nurse staffing in hospital wards. We aimed to assess whether the number of nurses predicted by these methods is appropriate or if new approaches and analyses are needed to calculate nurse staffing.

Materials and Methods

Setting

This single-center, retrospective observational study was conducted from January 1, 2021, to November 30, 2022, at the Emergency Department (ED) of Merano Hospital (53,842 admissions in 2021 and 66,465 in 2022). The ED is located in a peripheral hospital, and patients with severe time-sensitive conditions, such as stroke or major trauma, are transferred to the Bolzano Hub Hospital for further management. According to the Ministry of Health's guidelines, the ED under study is classified as a “simple ED” (“PS Semplice”).

Nurses performing triage at this ED use the Manchester Triage System (MTS), which categorizes patients into one of five severity levels.⁹ To qualify for triage duties, nurses are required to have a minimum of 2 years of experience in critical care, complete a 2-day triage training course, and undergo a mentorship period.

At our ED, nurses work 12-hour shifts, with the day shift running from 08:00 AM to 08:00 PM, and the night shift from 08:00 PM to 08:00 AM. During the day shift, two nurses are assigned to triage, while one nurse is dedicated to triage during the night shift.

Data collection

The data for this study were sourced from the database that is annually submitted to the Ministry of Health for monitoring Emergency Departments (EDs). To ensure privacy, the database is fully

anonymized. The data used in this study include: i) the patient's admission date, ii) the patient's admission time, iii) the duration of the triage assessment, and iv) the triage code assigned.

To calculate the time spent on triage for each patient, we measured the interval between the start and completion of the triage form for each individual patient. This interval was recorded in minutes.

All patients who accessed the ED during the study period and completed a triage assessment were included in the analysis. Patients who left the ED after registration but before completing triage were excluded from the study.

The study did not employ a formal sample size calculation but used consecutive enrollment, including all patients who presented to the ED during the study period. This approach ensured that the sample was representative of the population.

Nurse staffing calculation

To evaluate the nursing workload in triage, we applied established methods typically used for calculating nursing staff requirements in other hospital departments. The calculation was performed following the methodology outlined in previous studies,^{10,11} using the following steps: i) we calculated the average number of patient admissions during day and night shifts; ii) based on the data used in the study, we determined the distribution of patients by triage acuity code for each shift; iii) for each triage acuity code, we calculated the total time spent per shift by multiplying the number of patients (obtained in point i) by the average triage time required for each code; iv) we then calculated the total minutes spent on triage during each shift. By dividing this total by the available minutes per nurse (12 hours = 720 minutes), we estimated the number of nurses needed to manage triage effectively.

This calculation method is typically used in standard hospital wards to determine how many patients a nurse can manage during a work shift. It is based on the number of hours worked, divided by the average time required per patient. In this case, the method was adapted to the ED setting, using the average time needed to assign a triage code based on patient types.

Endpoint

The primary endpoint was to determine the number of nurses required per day for triage activities, divided into 12-hour day and night shifts.

Statistical analysis

The analysis was conducted by segmenting the database based on patient admission times, considering both day and night shifts for the nurses. Continuous variables were summarized using the mean and Standard Deviation (SD) or the median and Interquartile Range (IQR), depending on the distribution of the data. Categorical variables were presented as absolute numbers and percentages.

To assess triage times by the assigned triage code, boxplots were generated to evaluate the time spent at each severity level during both day and night shifts. To calculate the required triage staffing, the average number of daily triage assessments and the distribution of patients by triage code were computed. The mean triage time for each acuity level was multiplied by the number of patients assessed per day at that level to obtain the total minutes needed per shift. This total was then divided by the available minutes per nurse (12 hours per shift, or 720 minutes) to determine the staffing requirements. The analyses conducted were descriptive rather than comparative, aiming to determine the mean time required per patient based on the triage code type. This data was used to perform the standard calculation of the number of nurses needed.

All statistical analyses were performed using STATA 16.1 software.

Ethical considerations

The study was conducted in accordance with the guidelines of the local ethics committee (Ethics Committee for Clinical Research, South Tyrol Health Authority, Bolzano, Italy; approval number

28-2024) and adhered to the principles outlined in the Declaration of Helsinki for ethical medical research involving human subjects.

Results

During the 23-month study period, 109,464 patients were admitted to the Emergency Department (ED). Of these, 70.0% (76,646/109,464) presented during the day shift (8:00 AM - 8:00 PM), while the remaining 30.0% (32,818/109,464) presented during the night shift (8:00 PM - 8:00 AM) (Table 1).

The majority of patients who accessed the ED during the day shift were assigned a triage code 4 (68.9%) or code 3 (17.0%). Similarly, during the night shift, the most frequently assigned triage codes were code 4 (70.8%) and code 3 (13.6%). The median time spent on triage did not significantly vary across different triage codes (Figure 1). However, there was notable variation in the fourth quartile for priority codes 2, 3, and 4, indicating that a significant number of patients required more extensive assessments.

On average, 111 patients access the ED during a day shift. On average, during each day shift, there was 1 patient assigned the highest priority code (code 1), 5 patients assigned code 2, 19 patients assigned code 3, 76 patients assigned code 4, and 10 patients assigned code 5. These numbers reflect the distribution of patient acuity levels based on the triage codes used to prioritize care in the ED. The average triage times during the day shift were 46 minutes per patient for acuity code 5, 395 minutes per patient for acuity code 4, 119 minutes per patient for acuity code 3, 32 minutes per patient for acuity code 2, and 3.5 minutes per patient for acuity code 1. The number of nurses needed in triage was 0.82, and each nurse was required to assess 9.25 patients per hour (111 patients / 12 hours). The calculations performed and the formulas used are provided in Supplementary File 1.

During the night shift, an average of 47 patients accessed the ED: 1 patient with acuity code 1, 2 patients with acuity code 2, 6 patients with acuity code 3, 33 patients with acuity code 4, and 5

patients with acuity code 5. Based on this data, the calculation determined that 0.3 nurses were needed for the night shift, with an average of 4 patient assessments performed per hour (47 patients divided by 12 hours).

Discussion

This study assessed the nursing workload in triage using methodologies from other healthcare settings, demonstrating that the current calculation methods used in standard inpatient wards cannot be directly applied to the triage setting. This is due to the significantly higher number of assessments required per nurse in triage. Our analyses indicate that to evaluate 111 patients during a day shift, only 0.8 nurses are deemed sufficient according to national indications. This finding aligns with the Italian Ministry of Health guidelines, which recommend having one dedicated triage nurse for an ED of this type.² However, it is clear that expecting a nurse to accurately assess approximately 10 patients per hour is impractical. Continuous exposure to the fast-paced and complex environment of triage can lead to errors that affect the overall functioning of the ED.^{12,13} This highlights that, over time, the critical role of triage nurses has not received adequate attention, with more reliance placed on expert opinions rather than robust, contest-based calculations.² The calculation methods used in our study are based on formulas from other settings used to determine Full-Time Equivalent (FTE) staffing.¹¹ However, these calculations proved inadequate in the triage context, raising concerns about their validity in other settings as well. In inpatient settings, it is established that a nurse's time per patient is a maximum of one-third of the overall workload.^{3-5,11,14} In contrast, triage requires nurses to complete all evaluation and documentation within the recorded times. This demonstrates that the traditional approach is neither functional nor useful for triage. Accurate prospective studies are needed to assess the sustainable workload for triage nurses. In other contexts, it is evident that a nurse can manage only a maximum number of patients; exceeding this limit jeopardizes both patient safety and nurse performance.^{3,4,5,15} However, this consideration has been overlooked in the ED, where the Italian Ministry of Health does not

address the risks to patients or the workload of triage nurses.² Additionally, in the current state, it is not taken into account that the triage nurse is not only responsible for risk stratification of patients but also for monitoring, observing, and reassessing them during the waiting period, something that has not been considered until now.

These calculations typically account for other temporal factors, such as interruptions and conversations with relatives, which were not considered in this study. Despite this omission, the role of the triage nurse, while complex, involves the rapid and continuous assessment of patients. Even if 20% of the time (equivalent to 120 minutes or 2 hours) were allocated to other tasks, such as phone interruptions or interactions with waiting patients, the calculation would still indicate that only one triage nurse is needed.^{16,17} This highlights the necessity for developing alternative methods to calculate nursing staffing more systematically and scientifically.

An increasing number of studies and articles in the scientific literature underscores the delicate and complex nature of a triage nurse's work.¹² Long shifts and high workloads in this setting have been linked to a higher incidence of errors in triage code assignments.¹² Recent studies have also identified various factors influencing triage errors, including aspects related to staff, the ED environment, and the patients themselves.^{12,13,18,19} Given the challenging nature of the triage environment, it is questionable whether a single nurse can manage and assess such a high volume of patients effectively. Although our data align with the recommendations of the Italian Ministry of Health, we advocate for future prospective studies to address this issue with greater scientific rigor, similar to approaches taken in other fields. This is due to the clear impossibility of requiring a nurse to independently assess such a high volume of patients. Therefore, it is essential to develop alternative methods for accurately calculating the staffing levels that are needed in the triage setting. The study has some limitations. First, it is a single-center, retrospective analysis, which inherently introduces limitations associated with such study designs. Second, the time spent on additional activities or interruptions experienced by triage nurses was not included in the calculations. Nonetheless, the primary aim was to evaluate whether the current calculations and the

recommendations from the Ministry of Health are adequate for the triage context. Third, the workload calculation was based on average triage times and daily access numbers, without accounting for seasonal variations or holidays. However, triage should ideally remain unaffected by seasonality or holidays, and these variations are also not addressed by the ministerial guidelines or our hospital organization.

Conclusions

Our study has shown that the current guidelines from the Italian Ministry of Health, which are based solely on ED size, are inadequate for determining the necessary number of triage nurses. Additionally, staffing formulas used in other departments are not suitable for ED triage. These findings highlight the need for future research to develop a more accurate model for calculating nurse staffing in triage settings, taking into account the unique demands of the ED. Addressing this gap will be crucial for optimizing resource allocation and improving patient care in emergency departments.

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Table 1. Details on the triage process for patients enrolled in the study, including both priority codes and the average time spent per patient. The data presented in the table were used to calculate the number of ED nurses required for triage activities.

	Day shift	Night shift
Patients, n	76.646	32.818
Triage priority code, n (%)		
Acuity 1	272 (0.3)	127 (0.4)
Acuity 2	3.399 (4.4)	1.719 (5.2)
Acuity 3	13.020 (17.0)	4.470 (13.6)
Acuity 4	52.815 (68.9)	23.232 (70.8)
Acuity 5	7.140 (9.3)	3.270 (9.9)
Duration of triage, mean (SD)		
Acuity 1	3.5 (5.6)	2.4 (3.8)
Acuity 2	6.4 (5.9)	5.2 (5.1)
Acuity 3	6.3 (6.0)	6.0 (5.6)
Acuity 4	5.2 (5.6)	4.6 (5.1)
Acuity 5	4.6 (4.8)	4.1 (4.5)

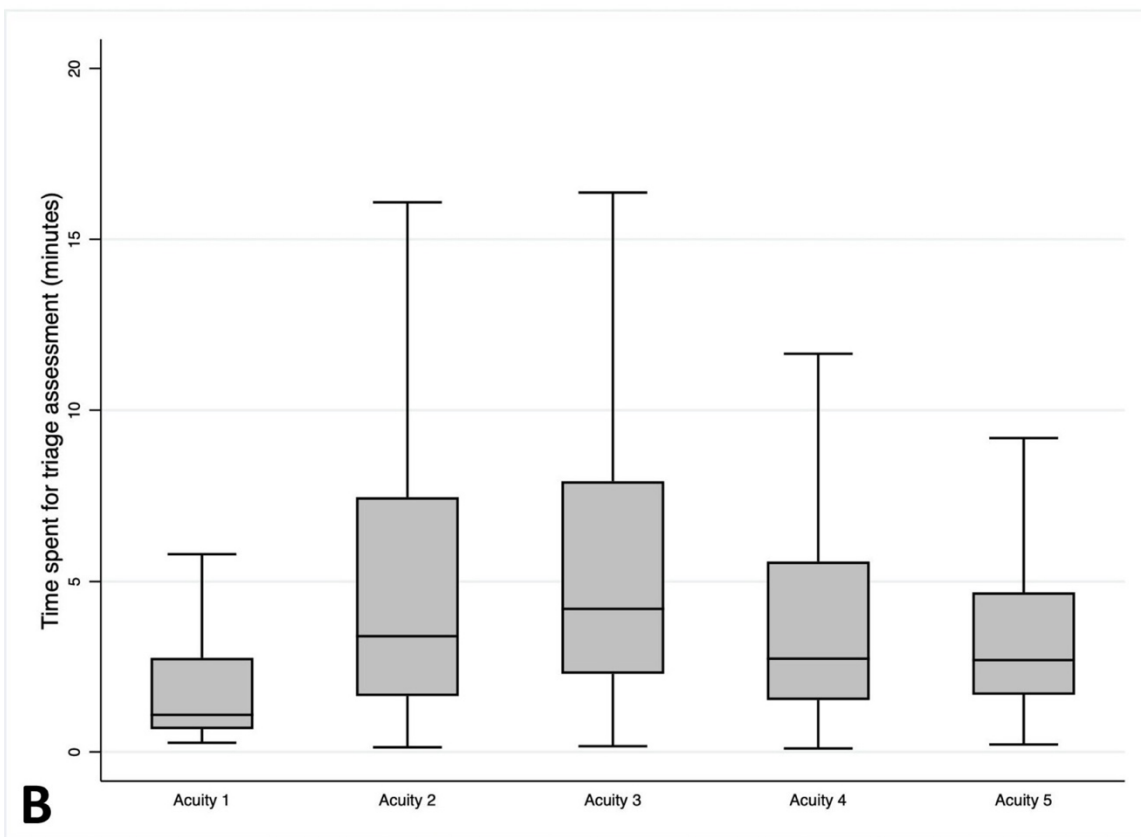
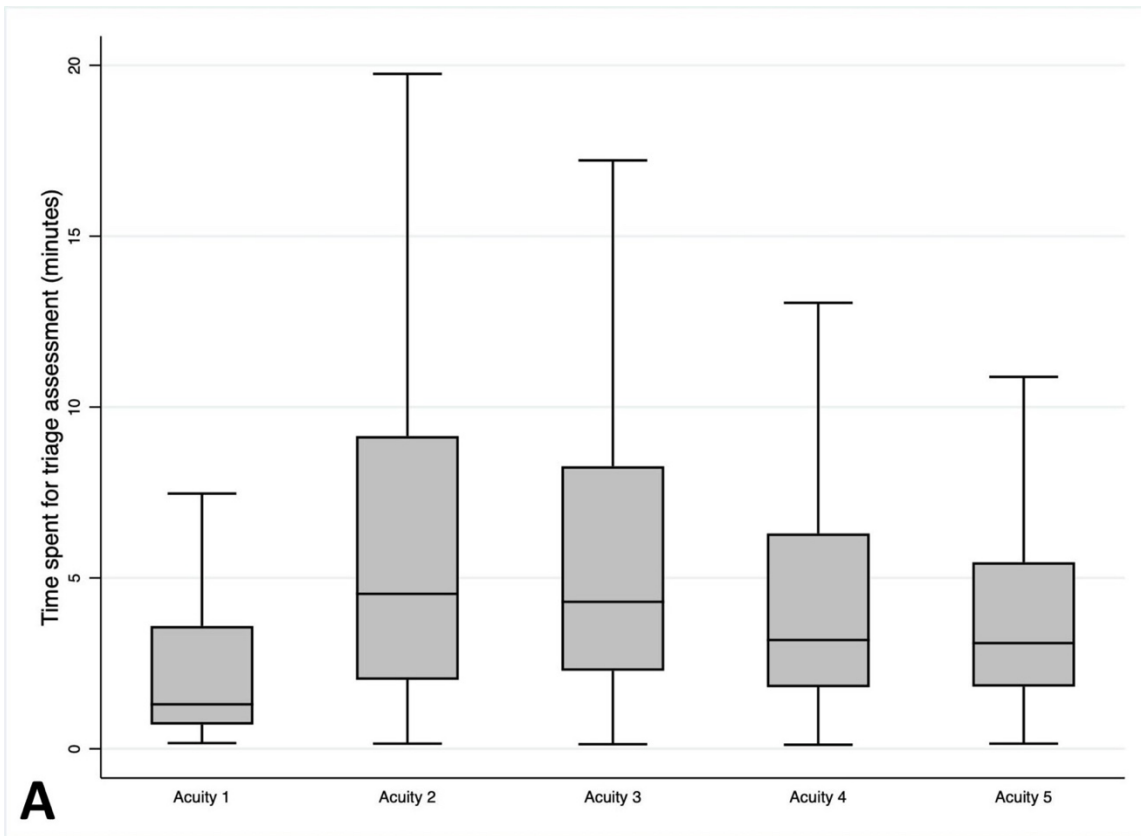


Figure 1: Boxplot of triage times based on priority code: Panel A shows the boxplots for day shifts, while Panel B shows the boxplots for night shifts.

Online supplementary materials

- 1) Calculation of the number of patients by color code for the daytime shift considering the daily average of visits.
- 2) Calculation of the average cumulative time spent performing triage based on the color code and for the daytime shift.
- 3) Calculation of the number of nurses needed in triage considering the daytime shift.