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Evaluation of Nurse-Led Triage Accuracy and Factors Associated with Triage Discordance in a Tertiary Care Emergency Department

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ABSTRACT

Objective: To evaluate the accuracy of nurse-led triage using a three-level institutional protocol in a tertiary care emergency department (ED) and identify predictors of triage discordance.

Methods: This cross-sectional study included 1,249 adult ED patients. Nurse-assigned triage levels were compared with emergency physician (EP) triage, considered the gold standard. Accuracy, under-triage, and over-triage rates were calculated. Cohen's Kappa (κ) assessed agreement. Univariate chi-square (χ^2) analysis was performed to identify associations between variables and triage inaccuracy, with odds ratios (OR) and 95% confidence intervals (CI) calculated from cross-tabulations.

Results: Triage accuracy was 94.6%, with 4.88% over-triage and 0.48% under-triage. Agreement between nurse and EP triage was κ = 0.91 (95% CI: 0.89–0.93), indicating excellent concordance. Univariate analysis identified significant associations between over-triage and elevated respiratory rate (≥25/min; p=0.002) and elevated systolic blood pressure (≥160 mmHg; p=0.039). Under-triage was rare (n=6, 0.48%). No variables significantly predicted under-triage.

Conclusion: Nurse-led triage demonstrated high accuracy and excellent agreement with emergency physicians. Over-triage occurred more often than under-triage and was strongly associated with abnormal physiological parameters. Reinforcement of vital-sign interpretation, structured training, and periodic audits may improve further accuracy in resource-limited settings.

Keywords: Triage accuracy; Under-triage; Over-triage; Emergency department; Physiological predictors; Kerala

INTRODUCTION

Triage plays a vital role in emergency departments by categorising patients by condition severity and ensuring timely care [1]. Although triage systems are widely

implemented worldwide, most validation studies originate from developed nations[2], leaving limited evidence regarding their accuracy and applicability in resource-constrained settings such as South Kerala.

Triage errors can significantly affect patient outcomes and resource utilisation. Under-triage, where critically ill patients are mistakenly assigned a lower priority, may delay critical interventions. In contrast, over-triage, where stable patients are classified as high priority, can contribute to overcrowding and inefficient use of resources [3,4]

This study aimed to evaluate the accuracy of nurse-led triage using an institutional three-level protocol in a tertiary care emergency department in South Kerala. Specifically, it sought to compare nurse-assigned triage levels with those assigned by emergency physicians, which was considered the gold standard, determine the incidence of under-triage and over-triage, and identify clinical and physiological factors associated with triage discordance.

MATERIALS & METHODS

Study Design and Setting

This was a cross-sectional observational analysis conducted from the Emergency Department of Pushpagiri Medical College Hospital, Kerala, India. This hospital has a 30-bed emergency unit and caters to approximately 60 patients daily. The study was carried out using the existing institutional triage protocol, which categorises patients into three priority levels based on physiological parameters and clinical assessment.

Participants

All patients aged 18 years and above presenting to the ED during the study period were included. Patients who were discharged against medical advice or underwent inter-hospital transfers were excluded from the study. Patients with burns covering more than 10% of their body surface area were also excluded due to the lack of an inpatient burn unit.

Ethical Considerations

The study was approved by the Institutional Ethics Committee with approval number PIMSRC/E1/388A/14/2018, Institutional Research Committee No. PIMS&RC/IRC/413/18 and was granted a waiver of consent to this study.

Study Protocol

Nurses assigned triage levels based on institutional protocols, which categorise patients into three priority levels (I, II, III). Emergency physicians then reassessed the patients and assigned their triage levels. The physician-assigned level was considered the gold standard. The primary outcome of interest was the accuracy of triage, defined as concordance between nurse-assigned and EP-assigned triage levels. Any discordance between the nurse-assigned and physician-assigned levels was classified as under-triage (patients assigned to a lower level than necessary) or over-triage (patients assigned to a higher level than necessary)[4]. Additional variables included patient demographics, vital signs (heart rate, respiratory rate, blood pressure), and clinical outcomes (ICU admission, ward admission, or discharge).

Study Size

The sample size was calculated based on a study conducted in South Africa[3], assuming a triage accuracy rate of 68.3% with a 5% margin of error, yielding a required sample size of 1,243 patients. A total of 1,249 patients were included in the final analysis.

Quantitative Variables

Vital signs and triage levels were recorded as continuous and categorical variables, respectively. The incidence of triage inaccuracies was analysed using regression models to identify predictors.

Data Sources and Measurements

Triage levels were recorded by nurses using institutional triage forms at patient presentation and by the emergency physician (EP) after clinical

assessment(fig.1). Clinical outcomes and follow-up data were obtained from patient case files and hospital records.

Bias Minimisation

Efforts were made to minimise bias by ensuring that nurses and emergency physicians worked independently during triage allocation. Standard protocols were followed to maintain consistency in data collection.

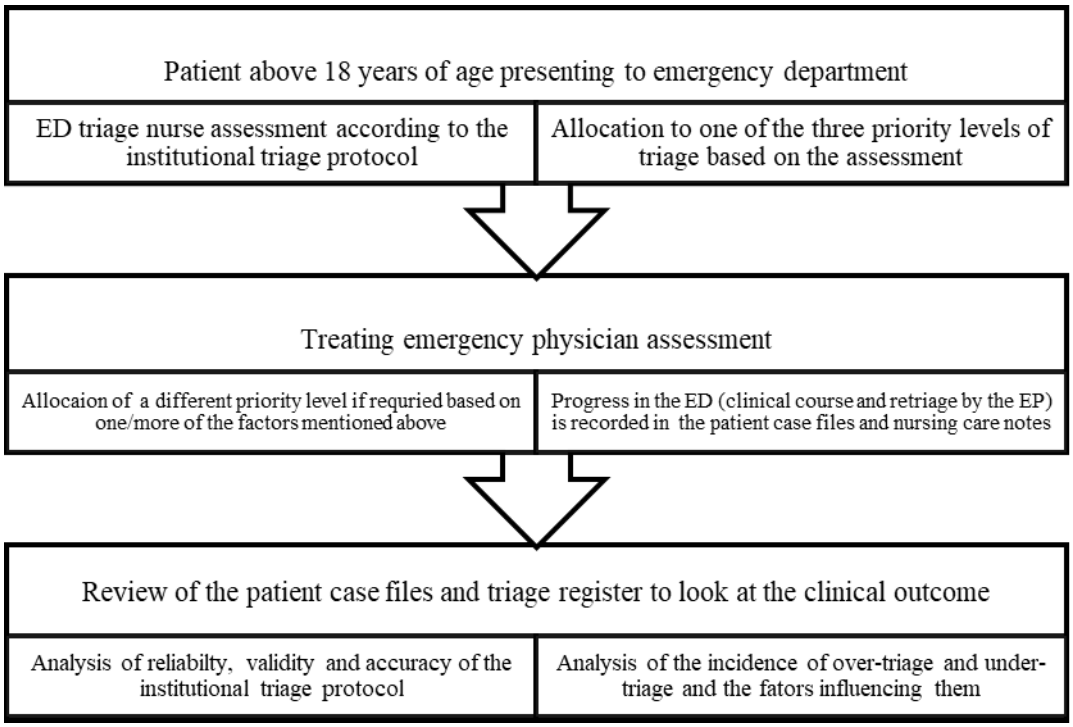

Fig.1: Methodology of the present study
ED: Emergency Department; EP: Emergency Physician

STATISTICAL ANALYSIS

Data were analysed using SPSS version 21. The accuracy of nurse-assigned triage was determined using Cohen's Kappa (κ) to measure concordance between nurse and EP triage levels, with 95% confidence intervals (CI). Univariate chi-square (χ^2) analysis was performed to identify associations between variables and triage inaccuracy. Odds ratios (OR) and 95% confidence intervals (CI) were calculated for significant associations from 2×2 contingency tables. A p-value < 0.05 is used to define statistical significance.

RESULT

Participant Characteristics

The study included 1,249 patients, of whom 55.2% were male, and 44.8% were female. The mean age was 50.5 years (SD = 21). Most patients (78.5%) presented during the day shift (8 AM–10 PM). (Table 1)

Table 1: Demographic Characteristics of the Study Population

Characteristic	**N (%)**
Total Participants	1,249
Gender	
Male	690 (55.2%)
Female	559 (44.8%)
Age (Mean ± SD)	
Mean ± SD	50.5 ± 21 years
Age Group	
< 60 years	747 (59.8%)
≥ 60 years	502 (40.2%)
Shift Timing	
Day Shift (8 AM–10 PM)	980 (78.5%)
Night Shift (10 PM–8 AM)	269 (21.5%)

N: Number; SD: Standard Deviation

Triage Accuracy

Nurse-assigned triage levels were accurate in 94.6% of cases, while 5.4% of cases were inaccurately triaged. Over-triage accounted for 4.88% of cases, whereas under-triage

was observed in 0.48% of cases. Cohen's Kappa between nurse and EP triage was κ = 0.91 (95% CI: 0.89–0.93), indicating excellent agreement. (Table.2)

Table 2: Concordance Between Nurse-Assigned and Physician-Assigned Triage Levels

Triage Level	Nurse Assigned (%)	Physician Assigned (%)
Priority I (life-threatening)	216 (17.3%)	189 (15.1%)
Priority II (urgent)	436 (34.9%)	434 (34.7%)
Priority III (minor)	597 (47.8%)	626 (50.1%)
Accuracy	94.6%	

Predictors of Inaccuracy

Univariate chi-square analysis revealed statistically significant associations between specific vital sign abnormalities and over-triage. Specifically, an elevated respiratory rate (≥25/min) was significantly associated with over-triage. This parameter was present in 77.0% (47/61) of over-triaged patients compared to 33.3% (2/6) of under-triaged patients (χ^2 = 9.89, p = 0.002). Elevated systolic blood pressure (≥160 mmHg) was significantly associated with over-triage. This parameter was present in 59.0% (36/61) of over-triaged patients compared to 50.0% (3/6) of under-triaged patients (χ^2 = 4.14, p = 0.039). Elevated heart rate (≥100 bpm) was not significantly associated with triage inaccuracy, present in 24.6% (15/61) of over-triaged patients compared to 33.3% (2/6) of under-triaged patients (χ^2 = 1.39, p = 0.241). Notably, under-triage was rare in this population (n=6; 0.48% of total sample), and the limited sample size precluded meaningful statistical analysis of risk factors for this outcome in univariate analysis. No statistically significant predictors of under-triage were identified, though the small sample size substantially limits the ability to detect associations. (Table 3)

Table 3: Univariate Chi-Square Analysis – Associations Between Vital Sign Parameters and Triage Inaccuracy

Variable	Under-Triage (n = 6)	Over-Triage (n = 61)	P-Value
Heart Rate (≥ 100 bpm)	2 (33.3%)	15 (24.6%)	0.241
Respiratory Rate (≥ 25/min)	2 (33.3%)	47 (77.0%)	0.002*
Systolic BP (≥ 160 mm Hg)	3 (50.0%)	36 (59.0%)	0.039*

Note: Data from univariate chi-square (χ^2) analysis of 67 inaccurately triaged patients (6 under-triaged, 61 over-triaged). Odds ratios and 95% CI calculated from cross-tabulations.
*p < 0.05 considered statistically significant. Due to the limited number of under-triaged cases (n=6), multivariate regression analysis was not performed.

DISCUSSION

Principal Findings

This study demonstrates high triage accuracy (94.6%) and excellent agreement (κ = 0.91) between nurses and emergency physicians. The accuracy achieved is higher than that reported in South Africa[3], Sweden[4], and Korea[6], suggesting effective implementation of the institutional protocol. Univariate chi-square analysis identified statistically significant associations between over-triage and both tachypnoea (RR ≥25/min, p=0.002) and elevated systolic blood pressure (SBP ≥160 mmHg, p=0.039). These findings align with studies[7] indicating that abnormal vital signs prompt higher priority assignments[5]. Under-triage was rare (0.48%, n=6) in this population, and the limited sample size precluded identification of specific predictive factors for this outcome.

Respiratory Rate (RR) is highly sensitive but not specific. Elevated RR is an early marker of distress and sepsis; nurses naturally prioritise safety by upgrading priority.

High Systolic Blood Pressure (SBP) triggers concern for hypertensive emergencies. Nurses may assign a higher priority due to fear of complications like

stroke, aortic syndromes, even when the clinical context does not warrant Priority I.

Comparison with International Literature

Goldstein et al. (South Africa) reported 68.3% accuracy[3] and Göransson et al. (Sweden) found moderate accuracy[4]. Korean triage systems also reported vital-sign-driven triage escalation[6]. Our accuracy of 94.6% is comparatively high, demonstrating effective nurse training and protocol familiarity.

Implications for Training and Policy

The following recommendations are proposed:

Reinforce interpretation of vital signs in the clinical context, especially RR and SBP

Conduct regular triage audits, focusing on over-triage reduction

Introduce decision-support tools, shown to improve triage consistency[5]

Provide simulation-based refresher training for triage nurses

Strengths and Limitations

Strengths:

Large sample size (1,249 patients)

Independent assessment minimising bias

Inclusion of physiological predictors with OR and CI

Comprehensive analysis of discordance patterns

Limitations:

Single-centre design limits generalizability

Under-triage numbers were too small for strong statistical conclusions

An additional significant limitation is the small number of under-triaged cases (n=6; 0.48% of sample). While univariate chi-square analysis was performed to explore associations between variables and triage inaccuracy, the small sample size of under-triaged patients substantially limits the statistical power to detect meaningful associations and restricts the generalizability of any findings for this outcome. Multivariate logistic regression analysis, which would require a minimum of 10-20 outcome events per predictor variable, was not statistically feasible with only 6 under-triaged cases. Future studies with larger sample sizes over extended study periods would be needed to adequately characterize patient and clinical factors associated with under-triage errors in this setting.

CONCLUSION

Despite the limitations, this study suggests that nurse-led triage, when based on institutional protocols, is highly effective in resource-limited settings like South Kerala. Regular training and validation of triage protocols are essential to minimise over-triage and ensure optimal patient outcomes. These findings apply to similar tertiary care centres in resource-limited settings. The study highlights the importance of context-specific triage protocols and the need for ongoing staff training to improve accuracy.

Declaration by Authors

Ethical Approval: Approved (Institutional Ethics Committee No. PIMSRC/E1/388A/14/2018)

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Conflict of Interest: The authors declare no conflict of interest.

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