



ORIGINAL ARTICLE

The accuracy of nurse-led triage of adult patients in the emergency centre of urban private hospitals

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ABSTRACT

Background: Triage is applied in emergency centres (ECs) to assign degrees of urgency to illnesses or injuries to decide in which order to treat patients, especially when there are many patients or casualties, facilitating the allocation of scarce medical resources. A triage nurse determines triage priority by assessing patients using an established triage tool with specific criteria. The South African Triage Scale is widely used in South African ECs. Although the South African Triage Scale has been adopted and implemented in both private and public healthcare ECs in South Africa, few studies have assessed the accuracy of nurse-led triage in private ECs.

Aim: To determine the accuracy of nurse-led triage in ECs in urban, private hospitals.

Methods: A quantitative, descriptive, retrospective study was done. Three private hospitals with similar average patient volumes were purposively selected. We sampled the nursing notes as follows: 1) we stratified nursing notes by nurse qualification and then 2) for each category of nurse we stratified nursing notes according to triage priority level and 3) then systematically randomly selected the recommended number of notes from each triage priority level for each nurse category. We retrospectively audited 389 EC nursing notes to determine the accuracy of nurse-led triage. For each note, we independently applied the South African Triage Scale, and then determined agreement between our score and the score determined by the triage nurse.

Results: We recorded 342 triage errors, consisting of triage early warning scores (TEWS) errors ($n = 168$), discriminator errors ($n = 97$) and additional investigation errors ($n = 77$). Overall agreement between the triage nurses and our scores was 71.7% ($n = 279$). Triage errors ($n = 110$) consisted of 3.9% ($n = 15$) over-triage errors and 24.4% ($n = 95$) under-triage errors. The highest level of agreement was between our scores and the scores of the emergency trained registered nurses (85%) and enrolled nursing assistants (78%).

Conclusion: In South African ECs, the South African Triage Scale is not always correctly applied, which can lead to almost a quarter (24.4%) of cases being under-triaged and not receiving timely care. Our results suggest that emergency trained registered nurses are well equipped to be triage nurses, and that this skill should be developed in South African nursing curricula.

African relevance

- Triage plays a key role in the safe and efficient management of the sometimes large numbers of patients presenting to South African and African Emergency Centres, hence accuracy must continuously be measured and evaluated.
- Our findings support the specialised roles of emergency trained registered nurses, who can take the lead in Emergency Centre triage.
- Continuous professional development is required to enable nurses to triage accurately and raise awareness of the important role nurses play in patient outcomes

Introduction

Emergency centre (EC) triage uses algorithms to differentiate patients requiring lifesaving interventions from those with less severe conditions, facilitating the allocation of scarce medical resources [1]. During triage, patients are prioritised for medical management in terms of urgency, contributing to shorter waiting times for urgent patients, streaming of less urgent cases and improved patient satisfaction [2]. During triage, a triage nurse briefly assesses patients presenting to the EC according to specific criteria which are defined in an established triage tool [3]. Numerous triage tools have been scientifically devel-

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oped, tested and integrated into EC practice worldwide. South African ECs use the South African Triage Scale (SATS). The SATS relies on a list of clinical signs (discriminators) and symptoms and the calculation of a Triage Early Warning Score (TEWS), a score calculated from the patient's physiological parameters (mobility, blood pressure, pulse rate), which is then used to determine the patient's triage priority level. Triage nurses may also consult a senior healthcare professional (SHCP) if they are unsure of the triage priority level. Each triage priority level stipulates a target time to medical management from initial contact with the patient. Triage priority red requires immediate management, orange requires management within ten minutes, yellow in less than one hour, and green within four hours [2].

Successful triage facilitates allocation of scarce resources, and facilitates the efficient management of patients, reducing mortality and morbidity [4]. Inaccurate triage may compromise the treatment and monitoring of patients, and may cause dangerous delays in medical treatment [5]. Delayed medical treatment may have disastrous outcomes for patients with time-sensitive conditions, such as percutaneous coronary intervention (PCI), and for patients with conditions such as asthma and sepsis, where the timeous administration of potentially life-saving medicines may save lives [6]. Treatment delays may also contribute to overcrowding in ECs and subsequent increased mortality and morbidity. Under-triage, or underestimating the urgency of treatment, is the most common form of inaccurate triage [6] and is associated with increased mortality compared to mortality of accurately triaged patients [7]. Over-triage may lead to limited resources being diverted to patients who do not require urgent medical management, potentially leaving those with greater need under-treated [6]. Over-triage may also result in an unwarranted burden and expenditure for trauma centres [4]. In settings that require triage, such as under-resourced or over-crowded settings, accurate triage is paramount and evaluating the process of triage is essential.

Although the SATS has been adopted and implemented in both private and public healthcare ECs in South Africa, few studies have assessed the accuracy of nurse-led triage in private EDs. This study aimed at determining the accuracy of nurse-led triage in private hospitals in Gauteng.

Setting

Data were collected in three urban private hospitals in Gauteng, a province in South Africa. Each hospital had a 24-hour EC that received patients of all ages. Each of these ECs treated on average 1 200 patients a month between August 2019 and December 2019. The nursing staff in the ECs included registered nurses (RNs) (some emergency trained), enrolled nurses (ENs) and enrolled nursing assistants (ENAs). Between one and two emergency doctors were on duty during the day and one emergency doctor on duty at night. Triage was exclusively performed by the nursing staff in a private triage room which connects directly to the EC reception and treatment area. After triage, the triage nurse will either return the patient to the reception waiting area, or if urgent medical care is required, the patient will be taken directly to the treatment area where a team of nurses and a doctor can provide immediate assistance.

Designs and methods

This was a quantitative, descriptive, retrospective study, which adhered to the STROBE checklist for observational research. Retrospective documentation review was the preferred method for data collection in order to avoid manipulation of the variables being studied. The Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria (No: 96/2020) approved the study. The study was also approved by the three hospitals where data were collected. In this study, we analysed EC nursing notes, a six page document of which the first page pertains to triage. The first page contains the patient's presenting complaint, identified discriminators, patient vital signs, Triage Early

Warning Score (TEWS), results from additional investigations, specifically haemoglucose test (HGT) and urine dipstick, and final triage priority allocation. We included the EC nursing notes of all adult patients (18 years of age and older) who presented to the ECs of the selected hospitals during the month of September 2019. We did not analyse the EC nursing notes of patients younger than 18 years, patients attending the EC for a follow-up visit, patients declared dead on arrival, or in cardiac arrest requiring immediate cardiopulmonary resuscitation, no triage priority level recorded and cancelled files.

We purposively selected three private hospitals with similar average patient volumes according to their electronic databases and to accurately represent the various nurse categories performing triage. We sampled the nursing notes as follows: 1) we stratified nursing notes by nurse qualification (RN, EN and ENA); 2) for each category of nurse, we stratified nursing notes according to triage priority level (red, orange, yellow and green) and 3) we then systematically randomly selected the recommend number of notes from each triage priority level for each nurse category (Table 1). The emergency trained nurses formed part of the RN's who were randomly sampled, for the purpose of comparative analysis they were recorded into two groups RN and Emergency nurses.

We developed an audit tool that included items based on SATS tool [8–16]. The audit tool had four sections: Section A: Demographics; Section B: Input (medical or trauma emergency), Section C: Process (1C: Patient's presenting complaint; 2C: Discriminator selection; 3C: TEWS calculation; 4C: Total TEWS score; 5C: Additional investigations) and Section D: Output (triage priority allocation). Before collecting data, two emergency nurse experts and a statistician evaluated the audit tool to determine construct and face validity. We piloted the audit tool by auditing eight EC nursing notes and did not make any changes. The data from the pilot study were not analysed.

Data were collected from June 2020 to August 2020, which took approximately 15 min per file and in total one and a half days were spent at each of the three hospitals. Using the information recorded on the EC nursing notes, a researcher (JS) triaged the patient by following the steps of the SATS. The researcher determined an appropriate discriminator, calculated the TEWS utilising the patient's recorded physiological parameters and noted if an additional investigation was indicated according to the patient's presenting complaint. After independently calculating the triage score, the researcher compared these triage decisions with those of the triage nurse according to each step in the SATS process, noting any disagreements. This method minimised potential bias. Data were collected by a researcher (JS) who is an emergency trained registered nurse who has worked in the private hospital group for eleven years, of which five were in the EC. The researcher (JS) has been training emergency nurses for the last three years, which includes training on triage and using the SATS tool. Nursing notes with incomplete information were excluded because no final triage priority could be allocated.

Data were captured in Microsoft Excel and analysed using the IBM SPSS Statistics version 26 software. Data were described using frequency tables (counts and percentages) and agreement levels were calculated as the number of concordance ratings between the researcher (JS) and EDs in selecting discriminators and TEWS calculation divided by total (concordance and discordant ratings).

Results

Demographic information

In September 2019, 3849 adult patients visited the ECs of the three hospitals. Of these patients, 3539 (91%) cases were allocated a triage priority. We sampled 447 files, of which 58 were incomplete and thus excluded. We audited 389 nursing notes, of which 140 were from Hospital 1 (36%), 128 from Hospital 2 (33%) and 121 were from Hospital 3 (31%). For the population size ($N = 3539$), the required representative sample was approximately 385 with the desired precision of 0.05

Table 1
Summary of sample sizes per hospital and triage nurse category ($N = 389$) for sampling emergency centre (EC) nursing notes to determine accuracy of the triage process in Gauteng, South Africa.

HOSPITAL	EMERGENCY TRAINED NURSES	REGISTERED NURSES	ENROLLED NURSES	ENROLLED NURSING ASSISTANTS
HOSPITAL 1	10	74	37	19
HOSPITAL 2	3	94	31	0
HOSPITAL 3	0	0	0	121
SUB-TOTAL	13 (3%)	168 (43%)	68 (18%)	140 (36%)

Table 2
TEWS observation related errors following re-triage of emergency department (ED) nurses notes.

TEWS observation	Individual physiological parameter TEWS allocation errors		Total Count (%)
	Missing TEWS allocation Count (%)	Incorrect TEWS allocation Count (%)	
Mobility	7 (1.8)	12 (3.1)	19 (11.3)
Respiration	11 (2.8)	20 (5.3)	31 (18.5)
Heart rate	5 (1.3)	19 (4.9)	24 (14.3)
Systolic blood pressure	7 (1.8)	8 (2.1)	15 (8.9)
Temperature	13 (3.3)	1 (0.3)	14 (8.3)
AVPU	7 (1.8)	2 (0.5)	9 (5.4)
Trauma	5 (1.3)	10 (2.6)	15 (8.9)
Total	55 (32.7)	72 (42.9)	127 (75.6)

and 95% confidence level. The sample size for this study was 389 (See Table 1).

Nursing notes included trauma (25.7%; $n = 100$) and medical (74.3%; $n = 289$) cases. Of the 389 nursing notes, 69.7% ($n = 271$) were recorded between 07:00 and 18:59, and 30.3% ($n = 118$) were recorded between 19:00 and 06:59. Most patients ($n = 168$; 43.2%) were triaged by RNs, followed by ENAs ($n = 140$; 36.0%), ENs ($n = 68$, 17.5%) and finally Emergency Nurses ($n = 13$, 3.3%). The triage nurses assigned cases as 24.2% ($n = 94$) green, 55.5% ($n = 216$) yellow, 19.0% ($n = 74$) orange and 1.3% ($n = 5$) red.

Triage errors

Possible triage errors include selecting the incorrect discriminator, TEWS related errors and omitting additional investigations when indicated. Following re-triage, we recorded 342 triage errors, which included discriminator errors ($n = 97$), TEWS errors ($n = 168$) and additional investigation errors ($n = 77$).

Discriminator errors

In instances where the author (JS) disagreed with the triage nurse’s discriminator selection, it was deemed a “missed discriminator”, implying the triage nurse “missed” the correct/ appropriate discriminator according to the patient’s reported signs and symptoms. There were a total of 97 (25.2%) discriminator errors of which the most frequently missed were severe pain and moderate pain. Severe pain was missed 51 times while moderate pain was missed 32 times. Of the under-triaged cases, 52.6% ($n = 50$) were due to missed pain discriminators.

TEWS related errors

A total of 168 TEWS related errors were identified. Errors included incorrect TEWS allocations (42.9%, $n = 72$) and missing TEWS allocations (32.7%, $n = 55$) for individual physiological parameters (see Table 2). In addition, TEWS errors for the final totalled TEWS accounted for 24.4% ($n = 41$), which included missing final total TEWS (4.1%, $n = 16$) and incorrectly calculated final total TEWS (6.7%, $n = 25$).

Additional investigation errors

We found 153 indications to perform additional investigations, of which 50.3% ($n = 77$) were not performed (See Table 3).

Triage accuracy

To assess the accuracy of nurse-led triage, we tested the level of agreement between nurse-led triage and our re-triage. We found an overall agreement of 71.7% ($n = 279$) between nurse-led triage and the re-triage rating, indicating triage errors in 28.3% ($n = 110$) of cases. Of the 28.3% incorrectly triaged cases, 3.9% ($n = 15$) were over-triaged and 24.4% ($n = 95$) were under-triaged. In terms of over-triage, triage nurses were more likely to put patients in the yellow category when they should have been in the green category (Table 4). In terms of under-triage, triage nurses were more likely to put patients in the yellow category when they should have been put in the orange category (Table 4).

Triage accuracy according to level of training

There was greatest agreement between triage by the researcher (JS) and emergency trained RNs (85%) and least agreement between the researcher (JS) and RNs (66%) (Table 5).

Discussion

We investigated the accuracy of EC triage led by triage nurses in a private hospital setting in South Africa. We noted triage errors in every step of the triage process, including TEWS errors, discriminator errors and additional investigation errors. While the TEWS does affect the allocation of the final triage score, one error may not necessarily result in a triage priority error. Triage scores are directly impacted by discriminators, and discriminator errors occur frequently in triage, most often in relation to pain [17–21]. Pain is scored according to the numeric pain rating scale with numbers 0 to 3 indicating mild pain, 4 to 6 indicating moderate pain and 7 to 10 indicating severe pain. If the recorded pain level did not match the discriminator rating (moderate or severe), the researcher recorded this as a pain discriminator error. Pain is often poorly documented [22], poorly judged [19] and poorly used as a discriminator

Table 3
Summary of additional investigation errors following re-triage of emergency department (EC) nurses notes.

Additional investigation	Indication for performing investigation	Number of times indicated to perform Count (%)	Number of omissions Count (%)
Haemoglucose test (HGT)	Reduced level of consciousness	8 (5.2)	5 (3.2)
	Unable to sit or move as normal	6 (3.9)	3 (1.9)
	Recent seizure	7 (4.5)	2 (1.3)
	History of diabetes	15 (9.8)	6 (3.9)
	Sub-total	36 (23.5)	16 (10.4)
Urine dipstick	Abdominal and/or back pain in females	59 (38.5)	21 (13.7)
	Diabetes and hyperglycaemia	11 (7.1)	9 (5.8)
	Sub-total	70 (45.7)	30 (19.6)
Pregnancy test	Abdominal and/or back pain in females of child-bearing age	47 (30.7)	31 (20.2)
	Sub-total	47 (30.7)	31 (20.2)
Total		153 (100)	77 (50.3)

Table 4
Summary of overall triage accuracy, comparing triage findings of the triage nurse and re-triage by the researcher (JS).

Over-triaged		
Triage nurse findings	Researcher (JS) findings	Over-triage count (%)
Red	Orange	1
Orange	Yellow	3
Yellow	Green	11
		15 (3.9)
Under-triaged		
Triage nurse findings	Researcher (JS) findings	Under-triage count (%)
Orange	Red	2
Yellow	Orange	67
Green	Orange	6
Green	Yellow	20
		95 (24.4)

Table 5
Summary of triage accuracy according to level of training of the triage nurses.

Triage nurse	Overall agreement Count (%)	Over-triage Count (%)	Under-triage Count (%)
emergency nurse	11 (84.6)	0 (0.0)	2 (1.8)
registered nurse	111 (66.1)	10 (9.0)	47 (42.7)
enrolled nurse	48 (70.6)	2 (1.8)	18 (16.3)
enrolled nursing assistant	109 (77.9)	3 (2.7)	28 (25.4)

[17], which is consistent with the findings of this study. By allocating pain correctly as a discriminator, we suspect that fewer cases would have been under-triaged (12.8% vs. 24.4%). Our findings support that triage nurses tend to under-assess pain levels, resulting in under-triage [23]. We also noted triage errors in neglecting to perform additional investigations when indicated, which could lead to under-triaging and under-treatment of patients in the EC. This increases medico-legal risks in the EC environment.

Currently, the American College of Surgeons Committee on Trauma (ACS COT) is the only society that recommends acceptable ranges for triage accuracy, recommending an under-triage rate of less than 5% and an over-triage rate of between 25 and 35 percentage [4]. In this study, we recorded an over-triage rate of 3.9%, well below the acceptable range of 25 to 35%. In contrast, we recorded under-triage rates of 24.4%, well above the acceptable range of less than 5%. Our findings are similar to triage errors reported in other local and international low to middle income (LMIC) settings [10,11,14,17,24] and suggest that nurses using the SATS are more likely to under-triage patients. The ACS COT define under-triage as trauma patients with an Injury Severity Score of 16 or

more who are taken to a non-trauma centre by pre-hospital emergency personnel [4]. In terms of the SATS tool, this means that the recommended under-triage rate of less than 5% only applies to “emergency” or “red” triage priority trauma patients. Under-triage of patients suffering from any life-threatening emergency, whether trauma or medical related, could have dire outcomes and should rightfully require an under-triage rate of less than 5%. This may however be an inappropriate and unrealistic benchmark against which to measure under-triage of “very urgent” or “urgent” patients who do not require immediate life-saving interventions.

Under-triaging of patients has been noted in other studies including non-trauma patients [17] and nurses who were less experienced with the tool [11]. Other contributing factors to triage errors include inaccurate measurement and recording of patient acuity [15], resource constraints and less skilled staff [25] and differences in patient populations or admission practices [18]. In this study, patients were most frequently under- and over-triaged due to incorrect discriminator selection.

We found the highest level of agreement between our re-triage and emergency trained RNs, followed by ENAs. This suggests that expert knowledge and experience in emergency nursing improves triage accuracy. Interestingly, ENAs also performed well, which may benefit private hospital EDs in low to middle income countries where emergency trained personnel are scarce and costly. We recommend that continuous SATS training and refresher courses be offered year round in the hopes that this could have a positive impact on triage accuracy [17].

Our study was restricted to three selected urban private hospitals in only one province of South Africa, and the findings are therefore limited to this setting. In addition, the small sample of emergency trained nurses could have positively exaggerated the percentage of accuracy with this group. As a retrospective study, we only had access to EC nursing notes, this presented two limitations, one being documentation inaccuracies, and the second that the researcher could not probe or clarify details. The nursing note audits were not checked for accuracy by a panel of experts hence there was no general agreement on the accuracy of the re-triage.

Conclusion

We identified errors in each step of the triage process with the most common errors being TEWS related errors followed by discriminator errors and additional investigation errors. Incorrect triaging occurred in 28.3% of triages, of which 3.9% (n = 15) were over-triaged and 24.4% (n = 95) were under-triaged. Incorrect allocation of the pain discriminator contributed significantly to under-triage. The study found emergency trained registered nurses to be the most accurate (85%) in the role of triage followed closely by ENAs (78%), while registered nurses were the least accurate. Our findings indicate that expert knowledge and experience in emergency nursing improves triage accuracy. There is also a need for improved triage accuracy if hospitals wish to mea-

sure against the ACS COT ranges [4], however ECs need to develop and define triage accuracy ranges that are relevant to low-resource settings. Scarce resources and high demands on ECs remains a challenge in South Africa. Continued measuring of triage accuracy is paramount if we wish to effectively manage these demands and improve patients' experiences in the EC.

Solutions

- Further accuracy studies are recommended in both public and private ECs to establish triage accuracy ranges relevant to ECs in South African settings.
- Developing EC triage task teams and a standardised SATS audit tool are recommended to continuously monitor triage accuracy and carry out corrective measures to minimise reoccurrence of errors.
- Further studies may need to include triage accuracy according to the nurse's level of training as this information is minimal at best.
- All staff must be trained on the use of the SATS and should repeat this training every two years, as is the case with many clinical competencies such as basic life support courses.

Authors' contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: JS 30%; TH and CJF 25% each; and AM 20%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Dissemination of results

The results from this study were shared with the emergency staff of the hospitals' involved.

Declaration of Competing Interest

The authors declared no conflicts of interest.

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