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ORIGINAL ARTICLE

A quality improvement study of the emergency centre triage in a tertiary teaching hospital in northern Ethiopia

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ABSTRACT

Introduction: An effective emergency triage system should prioritize both trauma and non-trauma patients according to level of acuity, while also addressing local disease burden and resource availability. In March 2012, an adapted version of the South African Triage Scale was introduced in the emergency centre (EC) of Ayder Comprehensive Specialized Hospital in northern Ethiopia.
Methods: This quality improvement study was conducted to evaluate the implementation of nurse-led emergency triage in a large Ethiopian teaching hospital using the Donabedian model. A 45% random sample was selected from all adult emergency patients during the study period, May 10th to May 25th 2015. Patient charts were collected and retrospectively reviewed. Presence and proper completion of the triage form were appraised. Triage level was abstracted and compared with patient outcome (dichotomized as "admitted to hospital or died" and "discharged alive from emergency centre") to quantify over- and under-triage triage.
Results: From 251 randomly selected patients, 107 (42.6%) charts were retrieved. From these, only 45/107 (42.1%) contained the triage form filled within the chart. None of the triage forms were filled out completely. From 13 (28.9%) admitted or deceased patients, the under-triage rate was 30.7% and from 32 (71.1%) patients discharged alive from the EC the over-triage rate was 21.9%.
Discussion: The under-triage rate observed in this study exceeds the recommended threshold of 5% and is a serious patient safety concern. However, under-triage may have been magnified by irregularities in the hospital admission process. Haphazard medical record handling, poor documentation, erroneous triage decisions, and poor rapport between nurses and physicians were the main process-related challenges that must be addressed through intensive training and improved human resource management approaches to enhance the quality of triage in the emergency centre.

African relevance

- Triage is still a novel concept in many African emergency centres.
- Appropriate methods of triage are essential for the effective functioning of an emergency centre.
- This study reflects the weaknesses of triage seen in many African emergency centre settings.

Introduction

The goal of triage is to prioritize patients who require the most urgent care and increase efficiency when resources are insufficient to treat all patients at once [1]. An effective emergency centre (EC) triage system should sort both trauma and non-trauma patients according to level of acuity [2], while also considering local disease burden and the health facility's resource availability [3,4]. While there are many validated in-hospital triage algorithms designed to meet different user needs [1,5,6], such as the five-level Emergency Severity Index recommended for use in hospitals in the United States [2], and the South African Triage Score (SATS) developed for use in South Africa [7,8], it is important to recognise that a triage scale developed in one country or region may not be applicable elsewhere.

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Ample evidence supporting the effectiveness of emergency triage to improve patient flow (efficiency), crowding, and outcomes has been generated in developed countries. Low-resource settings, however, face distinctive challenges that may significantly impact the choice of an appropriate triage scale and the success of its implementation. Examples of such challenges include shortages of material and human resources, poor record keeping practices, the ever-increasing triple disease burden of communicable disease, non-communicable conditions, and injuries, and limited access to health care for the general population [1,9,10]. Considering these complex differences, there is a surprising dearth of evidence on emergency triage implementation specifically in low-resource settings. In turn, ECs in developing countries have been given less attention by researchers and policy makers due to a general lack of locally relevant evidence [11].

As for most low-income countries, triage at the study site, an EC at an Ethiopian hospital, was non-existent until relatively recently. In January 2005, the Ethiopian Federal Ministry of Health endorsed the concept of triage as a patient flow management tool when it launched the Ethiopian Hospital Management Initiative in partnership with Yale School of Public Health and the Clinton Foundation HIV/AIDS Initiative [12]. In 2010, a national hospital performance monitoring system was introduced that incorporated 124 hospital management standards, several of which specifically mandated the conducting of emergency triage [13]. A manual with some technical detail on how to implement triage was provided to hospital administrations [14,15], but supervision visits revealed that triaging practice was not standardized between hospitals [16].

Opened in 2008, Ayder Comprehensive Specialized Hospital (ACSH) is a large referral and teaching institution affiliated with Mekelle University College of Health Sciences in Tigray Region, northern Ethiopia. From its outset, the EC at ACSH faced challenges similar to those observed in many other African settings, including inefficient patient flow, overcrowding, and poor patient outcomes [17]. To address these problems, and to comply with the national hospital management standards [14,15], nurse-led emergency triage was introduced in March 2012. ACSH management decided to use the South African Triage Score over other available triage algorithms because it was believed to best address the local circumstances [18], although certain components of the original SATS algorithm were adapted specifically for ACSH (Table 1).

Following the establishment of nurse-led emergency triage in ACSH EC, there was a need to assess whether it was being implemented properly. Recognizing the complexity of factors that could impact its implementation, we applied the Donabedian model [19] of quality improvement to frame our research in terms of structure, process, and outcome. The aim of this study was to evaluate the triage system at ACSH EC, focusing on process-level factors (Fig. 1). Our paper is one of the first that specifically evaluates the implementation process of an emergency triage system in an Ethiopian hospital. In addition, hospital managers as well as regional and national health stakeholders can use our results to improve the quality of triaging in Ethiopia.

Table 1
SATS adaptation for use in Ayder Comprehensive Specialized Hospital, Mekelle, Tigray, Ethiopia.

SATS Adult Triage Algorithm [7]	Adaptations for use in ACSH
Used for patients older than 12 years of age or 150 cm in height	• Used for patients older than 18 years of age in order to align with the Department of Paediatrics definition of "pediatric patient" • No height cut off is used, since the average Ethiopian is shorter than 150 cm.
Respiratory Rate from 9–14 is scored "0" and 15–20 is scored "1"	• Respiratory Rate from 9 to 20 is scored "0" based on consistent feedback from triage nurses. This could be related to the high altitude in Mekelle and different cardiovascular capacity of Ethiopians compared with South Africans.
Pregnancy with antepartum hemorrhage is not listed as a discriminator	• Pregnancy with antepartum hemorrhage added as a RED discriminator because of the high maternal mortality rate and priority placed on maternal health in Ethiopia.

Methods

This quality improvement study was conducted in the EC at ACSH, a tertiary teaching and referral institution located in Mekelle, the capital of the Tigray region, located in northern Ethiopia. Among other services, ACSH provides adult and paediatric emergency care to the 5.1 million residents of the Tigray region as well as parts of the neighbouring Afar and Amhara regions, treating between 1500 and 2000 emergency patients per month [17].

Mekelle University College of Health Sciences does not offer integrated post-graduate education in emergency medicine for physicians, and as a result, the EC at ACSH is physically and functionally fragmented along existing academic departmental lines. There are four separate examination rooms- medical, surgical, gynaecology and obstetrics, and paediatrics- each staffed by rotating clinicians from the respective academic departments. Prior to implementing emergency triage, nurses would classify arriving patients by department without performing any objective prioritization based on the patient's condition. With the introduction of the emergency triage system in March 2012, nurses were expected to assign a triage level based on an adapted SATS algorithm before sending or escorting the patient to the appropriate department based on their chief complaint. The triage nurse fills out a triage form (Fig. 2, data supplement) which is given to the treating physicians so they can prioritize patients by triage level, and the form is finally filed with the patient's chart. The triage nurse also keeps a simple logbook of triaged patients at the triage area. All emergency nurses received an initial half day in-service training on the new triage system prior to its roll-out.

ACSH's adapted SATS algorithm employs the Triage Early Warning Score (TEWS) to summarize the patient's physiological status. Using the calculation matrix shown in the triage form (Fig. 3), the triage nurse gives a value from 0 to 3 on seven parameters (respiratory rate, pulse rate, systolic blood pressure, temperature, mobility, level of consciousness, and exposure to trauma), and the sum total is the patient's TEWS.

Since physiology alone does not identify all patients needing urgent treatment, additional factors (referred to as "discriminators") are cross-checked that may classify the patient into a higher triage category, such as mechanism of injury, specific types of presentations, and level of pain. Fig. 4 lists the discriminators and associated triage levels adapted for use in ACSH. The patient is ultimately assigned the highest indicated colour code based on TEWS, mechanism of injury, presentation, level of pain, or a senior healthcare provider's discretion. The specific elements of the original SATS adult triage algorithm that were adapted for use in ACSH are summarized in Table 1, along with their justifications.

All patients over the age of 18 years who attended the ACSH EC during the two-week study period from May 10th to May 25th 2015 were eligible for inclusion in this study. The authors abstracted the medical record numbers of all eligible patients from the triage logbook to create the sampling frame. From 557 total eligible patients, a representative sample with 95% confidence level and 5% margin error was calculated to be 228 patients (40.9%).

Donabedian model applied to emergency triage in ACSH, Mekelle, Tigray, Ethiopia

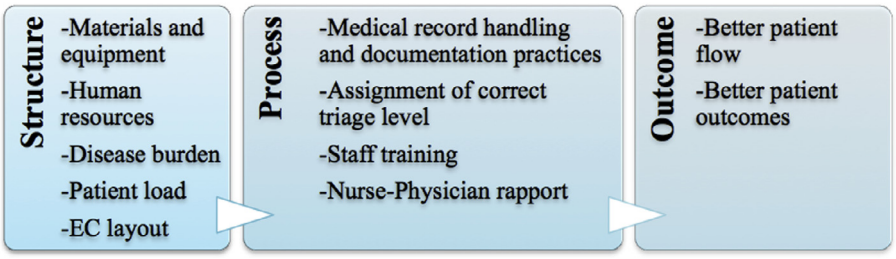

Fig. 1. Donabedian model applied to emergency triage at the study site.

ADULT TRIAGE EARLY WARNING SCORE (older than 18 years)							
	3	2	1	0	1	2	3
Mobility level				Walking	With help	Stretcher/ Immobile	
Respiratory Rate		≤ 8		9-20		21-30	> 30
Heart Rate		≤ 40	41-50	51-100	101-110	111-130	> 130
Systolic Blood Pressure	≤ 70	71-80	81-100	101-139	140-199	> 199	
Temperature		Feels cold OR ≤ 35°C		35°-38.4°C		Feels hot OR > 38.4°C	
Level of consciousness				Alert	Reacts to Voice	Reacts to Pain	Unresponsive
Trauma				No	Yes		

Fig. 3. Adult Triage Early Warning Score Calculator Matrix, adapted for use in ACSH from Wallis et al. [7].

Color Code	RED	ORANGE	YELLOW	GREEN	BLUE
Target time to treat	Immediate treatment or resuscitation	Treat the patient in less than 10 minutes	Treat the patient in less than 60 minutes	Treat within 4 hours	DEAD
TEWS	**7 or more**	**5-6**	**3-4**	**0-2**	
Mechanism of injury		High energy Transfer			
Presentation		Shortness of breath - acute		ALL OTHER PATIENTS	
		Coughing blood			
		Chest Pain			
		Hemorrhage - uncontrolled	Hemorrhage - controlled		
	Seizure – current	Seizure - postictal			
		Focal neurology - acute			
		Reduced level of consciousness			
		Psychosis / Aggression			
		Threatened limb			
		Dislocation - other joint	Dislocation - finger or toe		
		Fracture - compound	Fracture- closed		
	Burn – face Burn- inhalation	Burn over 20% Burn - electrical Burn - circumferential Burn - chemical	Burns - other		
		Poisoning / Overdose	Abdominal pain		
	Hypoglycaemia – glucose<60mg/dl	Diabetic- glucose>200mg/dl Diabetic- ketonuria	Diabetic – glucose >300 mg/dl (no ketonuria)		
		Vomiting - fresh blood	Vomiting - persistent		
	Pregnancy & antepartum hemorrhage	Pregnancy & abdominal trauma or pain	Pregnancy & other trauma		
Pain level	Severe		Moderate	Mild	
	Senior Healthcare Professional's Discretion				

Fig. 4. Adult Emergency Triage Algorithm, adapted for use in ACSH from Wallis et al. [7].

Ultimately, a 45% sample of patients was randomly selected and the selected medical record numbers were submitted for chart retrieval. The authors reviewed the charts and abstracted data from the triage forms filed within. Data was initially entered in Microsoft Excel, and Stata Version 12 was used to clean the data and compute descriptive statistics.

We chose several process-level measures to assess the quality of the triage system [20]. Presence of the triage form within the patient chart and full completion of the triage form related to medical record handling and documentation practice. This was an important way to retrospectively assess the level of ownership, accurate use, and functionality of the triage system. The rate of over-triage and under-triage measured whether the triage system was safely and efficiently classifying patients. Over-triage was defined as patients who were triaged as Red or Orange but were discharged alive from the EC. Under-triage was defined as patients who were triaged as Green but were later admitted for inpatient care or died in the EC. Patients' outcome (admitted to inpatient care, died in EC, or discharged alive from EC) was ascertained by reviewing the patients' chart. These definitions were based on the assumption that patients who were admitted or died in the EC were in reality high acuity cases that should be captured by a more severe triage level (Red or Orange) [8,18,21–23]. The American College of Surgeons Committee on Trauma (ACS-COT) guideline suggests that under-triage is acceptable at a threshold level up to 5%, while over-triage is acceptable from 25% to 35% [24].

The study procedures were approved and conducted in compliance with the Health Research Ethics Review Committee of College of Health Sciences, Mekelle University and all abstracted data was de-identified to protect patient confidentiality.

Results

Review of the triage area logbook identified a total of 557 eligible patients during the study period and 251 were randomly selected for inclusion in the study. From these, 42.6% (N = 107) of the charts were able to be located by the medical record unit. From the available 107 charts, only 42.1% (N = 45) contained the triage form filed within as expected and were included in the analysis.

Table 2 shows patients' demographic profiles and triage results by outcome status. The mean age of the study patients was 38.16 years (SD: ±19.1, 95% CI: 32.46–43.86) and 64.4% (N = 29) were male. Admitted patients were on average significantly older than non-admitted patients ($p < 0.001$). Most patients (N = 32, 71.1%) were discharged alive from the EC, while 28.9% (N = 13) were admitted to the hospital. There were two deaths in the medical ward, and no recorded deaths in the EC. The most common chief complaints were abdominal pain (N = 8, 17.8%), fever (N = 5, 11.1%), chest pain (N = 4, 8.9%), headache (N = 4, 8.9%), and diarrhoea/vomiting (N = 4, 8.9%). During the study period, 11.1% (N = 5) of the patients were triaged to Red, 15.6% (N = 7) were triaged to Orange, 33.3% (N = 15) to Yellow, and 33.3% (N = 15) to Green.

None of the 45 triage forms were filled out completely. Patient medical record number and name were completed for all patients, and age and sex were completed over 95% (N = 43) of the time, but over 80% (N = 37, 82.2%) were missing the patient's address. Date (N = 37, 88.3%), time (N = 41, 91.1%), and mode (N = 28, 62.2%) of arrival were completed on the majority of the triage forms. Information about pre-hospital first aid was only recorded in two cases, and referral source was only recorded for 33.3% (N = 15) of the cases. Triage nurses did not consistently record the examination room where the patient should be treated.

Heart rate was the most consistently recorded vital sign with a 97.8% completion rate (N = 44), followed by systolic blood pressure (N = 42, 93.3%), temperature (N = 39, 86.7%), exposure to trauma (N = 38, 84.4%), mobility (N = 37, 82.2%), respiratory rate (N = 37, 82.2%), and level of consciousness (N = 37, 82.2%). The final summed TEWS was not recorded in eleven case**s**. From these, five were assigned a triage level without any additional justification, three were assigned triage levels based on discriminating factors, and three had no final triage level recorded at all. Discriminating factors (injury mechanism, presentation, pain level) were recorded in 21 cases, and in six of those cases, the discriminators were used to assign a higher triage level than would have been indicated by TEWS alone.

In this study, rates of over- and under-triage were calculated relative to admission to inpatient care or EC death, on the assumption that high acuity patients would reach such outcomes and low acuity patients would generally not [8,22,23]. From the 13 admitted patients, four were triaged as Green giving an under-triage rate of 30.7% (two medical, two surgical) and from 32 patients discharged alive from the EC, seven were triaged as Red or Orange for an over-triage rate of 21.9%. All of the over triaged patients were medical cases.

Table 3 cross-tabulates patients' triage level and admission status using Cribari grid method [22,23].

Discussion

This quality improvement study aimed to evaluate process-level factors related to the implementation of emergency triage in the EC of a large Ethiopian teaching hospital. Because the concept of emergency triage is still relatively new in the Ethiopian health system, the findings of the study have implications for other hospitals and health sector stakeholders as they look to implement or improve triage systems.

We looked at presence of the triage form in patients' charts and full completion of the triage form as indicators for the level of ownership, accurate use, and functionality of the triage system. Nearly 60% (62/107) of the available charts were missing the triage form, and none (0/45) of the triage forms we reviewed were filled out completely. On top of that, over half (144/251) of the originally requested patient charts were not able to be located by hospital staff at all. These findings point to inexcusable flaws in the medical record handling and documentation practices at ACSH. Aside from potentially disastrous impacts on the quality of patient care, this severely limits us from drawing any generalizable conclusions from our study results. A systematic review including 59 low- and middle-income countries (LMICs) also concluded that quality of medical recording is a major challenge for measuring the state of emergency care in LMICs [11]. This study confirms that poor medical records handling and documentation can hamper efforts to address quality issues within hospitals.

Our finding suggests that hospital staff did not consider the triage form to be an important part of the patient's medical record. Consequently, staff were not utilizing the form to achieve the desired functions like communicating the patient's priority (triage level) to the treating physicians or documenting the patient's baseline presentation in order to monitor changes in status. The researchers discussed the issue of missing triage forms with hospital management, and as a result EC staff were reminded that the triage form was a legal component of the patients' medical record and should be retained in the patient chart.

The poor completion rate of certain sections of the triage form suggests that triage nurses were either not familiar enough with the triage algorithm, or did not consider certain elements to be relevant in their fast-paced work environment. One of the most concerning gaps was the lack of thorough nursing documentation concerning calculation of the TEWS, or their reasons for adjusting

Table 2
Patient demographics and triage findings by outcome status in ACSH, March 2015.

Variable	Category	Discharged alive from EC (N = 32)	Died in EC or Admitted (N = 13)	Total (N = 45)
Gender	Male	20 (62.5%)	9 (69.2%)	29 (64.4%)
	Female	10 (31.3%)	4 (30.8%)	14 (31.1%)
	Missing or Illegible	2 (6.2%)		2 (4.5%)
Age	Age (years)	30.71 (± 14.4)	57.41 (± 16.4)	38.16 (± 19.1)
	Missing or Illegible	1 (3.1%)	1 (7.7%)	2 (4.4%)
Address	Urban	3 (9.4%)	1 (7.7%)	4 (8.9%)
	Rural	2 (6.2%)	2 (15.4%)	4 (8.9%)
	Missing or Illegible	27 (84.4%)	10 (76.9%)	37 (82.2%)
Pre-hospital first aid given?	Yes	0	0	0
	No	2 (6.2%)	0	2 (4.4%)
	Missing or illegible	30 (93.8%)	13 (100%)	43 (95.6%)
Mode of Arrival	Ambulance	5 (15.6%)	3 (23.1%)	8 (17.8%)
	Private car	3 (9.4%)	5 (38.4%)	8 (17.8%)
	Taxi/bajaj	3 (9.4%)	2 (15.4%)	5 (11.1%)
	Walking	6 (18.7%)	0	6 (13.3%)
	Carried	1 (3.1%)	0	1 (2.2%)
	Missing or illegible	14 (43.8%)	3 (23.1%)	17 (37.8%)
Referral Source	Health Centre	5 (15.6%)	0	5 (11.1%)
	Government Hospital	1 (3.1%)	2 (15.4%)	3 (6.7%)
	Private Hospital	1 (3.1%)	2 (15.4%)	3 (6.7%)
	Self-Referred	2 (6.2%)	0	2 (4.4%)
	Missing or Illegible	23 (72.0%)	9 (69.2%)	32 (71.1%)
Chief Complaint	Non-Trauma	22 (68.8%)	9 (69.2%)	31 (68.9%)
	Trauma	8 (25.0%)	1 (7.7%)	9 (20.0%)
	Missing or Illegible	2 (6.2%)	3 (23.1%)	5 (11.1%)
TEW Score	0–2	8 (25.0%)	4 (30.8%)	12 (26.7%)
	3–4	8 (25.0%)	6 (46.1%)	14 (31.1%)
	5–6	4 (12.5%)	1 (7.7%)	5 (11.1%)
	7 or more	2 (6.2%)	1 (7.7%)	3 (6.7%)
	Missing or Illegible	10 (31.3%)	1 (7.7%)	11 (24.4%)
Triage Level	Green	11 (34.4%)	4 (30.8%)	15 (33.3%)
	Yellow	11 (34.4%)	4 (30.8%)	15 (33.3%)
	Orange	5 (15.6%)	2 (15.4%)	7 (15.6%)
	Red	2 (6.2%)	2 (15.4%)	4 (8.9%)
	Missing or Illegible	3 (9.4%)	1 (7.6%)	4 (8.9%)
Exam room assignment	Medical Exam	8 (25.0%)	5 (38.5%)	13 (28.9%
	Surgical Exam	4 (12.5%)	0	4 (8.9%)
	Missing or Illegible	20 (62.5%)	8 (62.5%)	28 (62.2%)

Table 3
Contingency table showing triage level and admission status.

Triage Level	Outcome		Row Total
	Discharged alive from EC	Died in EC or admitted	
Red	2*	3	5
Orange	5*	2	7
Yellow	11	4	15
Green	11	4^	15
Not Recorded	3	0	3
Column Total	32	13	45
Under-triage Rate^	4/13 = 30.7%	Ideally < 5% [24]	
Over-triage Rate*	7/32 = 21.9%	Ideally 25–35% [24]	

the calculated TEWS based on presence of discriminators. Similar issues were faced in Kumasi, Ghana, where nurses failed to document reasons for adjusting the calculated TEWS [9], and in Gauteng, South Africa where 57.8% of triage errors were due to improper of non-existent use of the discriminator list, and 21.5% were due to mathematical miscalculations [25]. Although failure to document does not necessarily equate with a lack of judgment on the part of the triage nurses, haphazard re-assignment of patients without following the established algorithm could result in mis-triage and this have serious ramifications for patient safety.

This study found an under-triage rate of 30.7%, which is much higher than the ACS-COT threshold of less than 5% [24]. Under-triage is a serious concern for the quality of patient care, causing patients with serious health threats to experience dangerous delays in accessing definitive care and leading to increased morbidity and mortality. A study on SATS implementation in a teaching hospital in Ghana reported a much lower under-triage rate of 5.7%, however, they used expert chart review to determine actual patient acuity level [9] versus our study which used patient admission status or EC death as a proxy for this. A study conducted in KwaZulu-Natal, South Africa also used hospital admission status to determine true patient acuity and found a lower under-triage rate of 4.4% [18]. Above and beyond incorrect triaging due to human error, our use of hospital admission as a proxy for patient acuity probably contributed to the high under-triage rate we observed. The hospital admission process in ACSH is convoluted and patients who are denied hospital admission through the regular outpatient department are known to attempt admission through the EC for non-acute or chronic medical conditions.

The over-triage rate observed in ACSH (21.9%) was close to the ACS-COT recommendation of 25–35% but was higher than that reported in Ghana (1%) and South Africa (4.3%) [9,18]. Over-triage does not directly decrease patients' well-being in the same way as under-triage, and practitioners are in fact encouraged to err on the side of over-triage. However, excessive over-triage

may indirectly reduce the collective quality of care by diversion of limited resources from patients who are truly higher priority cases, which can be serious especially in resource-constrained settings.

Several additional structural factors emerged as concerns impacting the implementation of emergency triage at ACSH, most notably the fragmented nature of the EC, material shortages, and human resource management issues (Fig. 1). The division of the ACSH EC by academic department (medical, surgical, gynaecology and obstetrics, paediatrics) continues to encourage nurses to sort patients by type rather than severity of their condition. Furthermore, the constant rotation of different physicians to the EC from the respective academic departments degrades communication channels and makes it difficult to establish any lasting changes, especially since no orientation is provided to incoming physicians about daily EC operations. It is also important to note that the ACSH standard nurse-to-patient ratio of 1:2 was not met during the study period, and especially poor staffing ratios were observed during busy hours. This, in combination with the high patient load could have contributed to the poor quality of documentation we observed.

There are also some additional process-related factors also deserve discussion including nurse-physician rapport and staff training (Fig. 1). Poor rapport between nurses and physicians was repeatedly mentioned by EC staff during the course of the study. Physicians had never been trained on emergency triage, and this posed a barrier to the functioning of the system. As a result, an in-service training on triage for physicians was conducted, but this still did not address the issue of constant physician rotation. Physicians should have been included in the implementation process from the beginning so could interpret the triage levels and prioritize patients accordingly. Understanding of the triage algorithm and proper completion of the triage form can only be improved through training and effective communication can only occur if all involved stakeholders receive the same training. Additionally, the nurses had only received one half day's training on the triage algorithm in March 2012. This was clearly insufficient and did not address the issue of nurse turnover.

This study is limited by its small sample size and potential selection bias induced by the high proportion of missing patient charts and triage forms. In order to increase the validity and reliability of the quality assessment, more patient files could have been analysed for a greater period of time; however, due to time constraints this was not possible. Additionally, our use of hospital admission status as the outcome for calculating under- and over-triage is arbitrary and may not be an accurate reflection of the patient's true acuity as we assumed it to be.

In conclusion, prior to the introduction of the adapted SATS emergency triage algorithm at ACSH EC, patients were merely being sorted by department (medical, surgical, obstetrics and gynaecology, paediatrics) and there was no objective classification of patients based on acuity. Thus, implementation of emergency triage has been an important advancement for ACSH EC. The results of this study were disseminated to the hospital management and led to an isolated in-service training on the triage system for nurses and some physicians. We recommend that all current EC staff complete a thorough and intensive training on the triage system, and that completion of such a training should be required for all new health providers prior to working in the EC to address turnover of both physicians and nurses. Competencies in triage should also be integrated into periodic performance appraisals with opportunities for refresher training. Such a training drive would also present the opportunity to introduce the more recently updated version of SATS [26,27]. We also recommend adoption of staffing policies that allow for flexibility to meet the demands of patient influx at triage during busy times. In addition, we forward that establishment of a Department of Emergency Medicine in Mekelle University College of Health Sciences would help to smooth the implementation of emergency triage and streamline the overall operation of the EC in ACSH.

Conflicts of interest

The authors declare no conflict of interest.

Dissemination of results

Results from this study were shared with staff members at Ayder Comprehensive Specialized Hospital (ACSH).

Author's contributions

RA, HY, and HT conceived the original idea and designed the experiments. RA collected the data and carried out analysis of data along with HY. RA, HY, and HT drafted the manuscript, revised it and approved the final version that was submitted.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.afjem.2017.05.009.

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