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ORIGINAL ARTICLE

Evaluation of a modified South African Triage Score as a predictor of patient disposition at a tertiary hospital in Rwanda

Chantal Uwamahoro[a], Adam R. Aluisio[b], Esther Chu[c], Ellen Reibling[c], Zeta Mutabazi[a], Naz Karim[b], Jean Claude Byiringiro[d], Adam C. Levine[b], Mindi Guptill[c,*]

[a] *Department of Anesthesia, Emergency Medicine and Critical Care, University of Rwanda College of Medicine and Health Sciences, Kigali, Rwanda*
[b] *Department of Emergency Medicine, Warren Alpert School of Medicine, Brown University, 55 Claverick Street, Providence, RI 02903, USA*
[c] *Department of Emergency Medicine, Loma Linda University School of Medicine, 11234 Anderson Street, Loma Linda, CA 92354, USA*
[d] *Department of Surgery, School of Medicine and Pharmacy, University of Rwanda College of Medicine and Health Sciences, Kigali, Rwanda*

A R T I C L E I N F O

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South African Triage Score
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A B S T R A C T

Background: Triage is essential for efficient and effective delivery of care in emergency centers (ECs) where numerous patients present simultaneously with varying acuity of conditions. Implementing EC triage systems provides a method of recognizing which patients may require admission and are at higher risks for poor health outcomes. Rwanda is experiencing increased demand for emergency care; however, triage has not been well-studied. The University Teaching Hospital of Kigali (UTH-K) is an urban tertiary care health center utilizing a locally modified South African Triage Score (mSATS) that classifies patients into five color categories. Our study evaluated the utility of the mSATS tool at UTH-K.

Methods: UTH-K implemented mSATS in April 2013. All patients aged 15 years or older from August 2015 to July 2016 were eligible for inclusion in the database. Variables of interest included demographic information, mSATS category, patient case type (trauma or medical), disposition from the ED and mortality.

Results: 1438 cases were randomly sampled; the majority were male (61.9%) and median age was 35 years. Injuries accounted for 56.7% of the cases while medical conditions affected 43.3%. Admission likelihood significantly increased with higher triage color category for medical patients (OR: Yellow = 3.61, $p < .001$ to Red (with alarm) = 7.80, $p < .01$). Likelihood for trauma patients, however, was not significantly increased (OR: Yellow = .84, $p = .75$ to Red (with alarm) = 1.50, $p = .65$). Mortality rates increased with increasing triage category with the red with alarm category having the highest mortality (7.7%, OR 18.91).

Conclusion: The mSATS tool accurately predicted patient disposition and mortality for the overall ED population. The mSATS tool provided useful clinical guidance on the need for hospital admission for medical patients but did not accurately predict patient disposition for injured patients. Further trauma-specific triage studies are needed to improve emergency care in Rwanda.

African relevance

- This is the first study of triage systems in Rwanda.
- The findings may guide future research on triage systems in Rwanda and other African settings.
- It may also provide valuable feedback to Rwandan medical leaders about triage and disposition at their referral hospital.

Introduction

Triage is essential for efficient and effective delivery of care in emergency centers (ECs) where numerous patients present simultaneously with varying acuity of conditions [1,2]. Implementing EC triage systems provides a method of recognizing which patients may require admission and are at higher risks for poor health outcomes [3,4]. Triage systems categorize patients by level of acuity ranging from non-urgent to life-threatening and guide how rapidly patients should be evaluated and treated based on specific criteria of clinical urgency [5–7]. The

* Corresponding author at: Department of Emergency Medicine, 11234 Anderson St., MC-A890A, Loma Linda, CA 92354, USA.
E-mail addresses: uwmchantal@yahoo.fr (C. Uwamahoro), adam.aluisio@gmail.com (A.R. Aluisio), echu@llu.edu (E. Chu), ereibling@llu.edu (E. Reibling), mutabalphos@yahoo.fr (Z. Mutabazi), nazkarim5@gmail.com (N. Karim), jcbyiringiro@gmail.com (J.C. Byiringiro), adam_levine@brown.edu (A.C. Levine), mguptill@llu.edu (M. Guptill).

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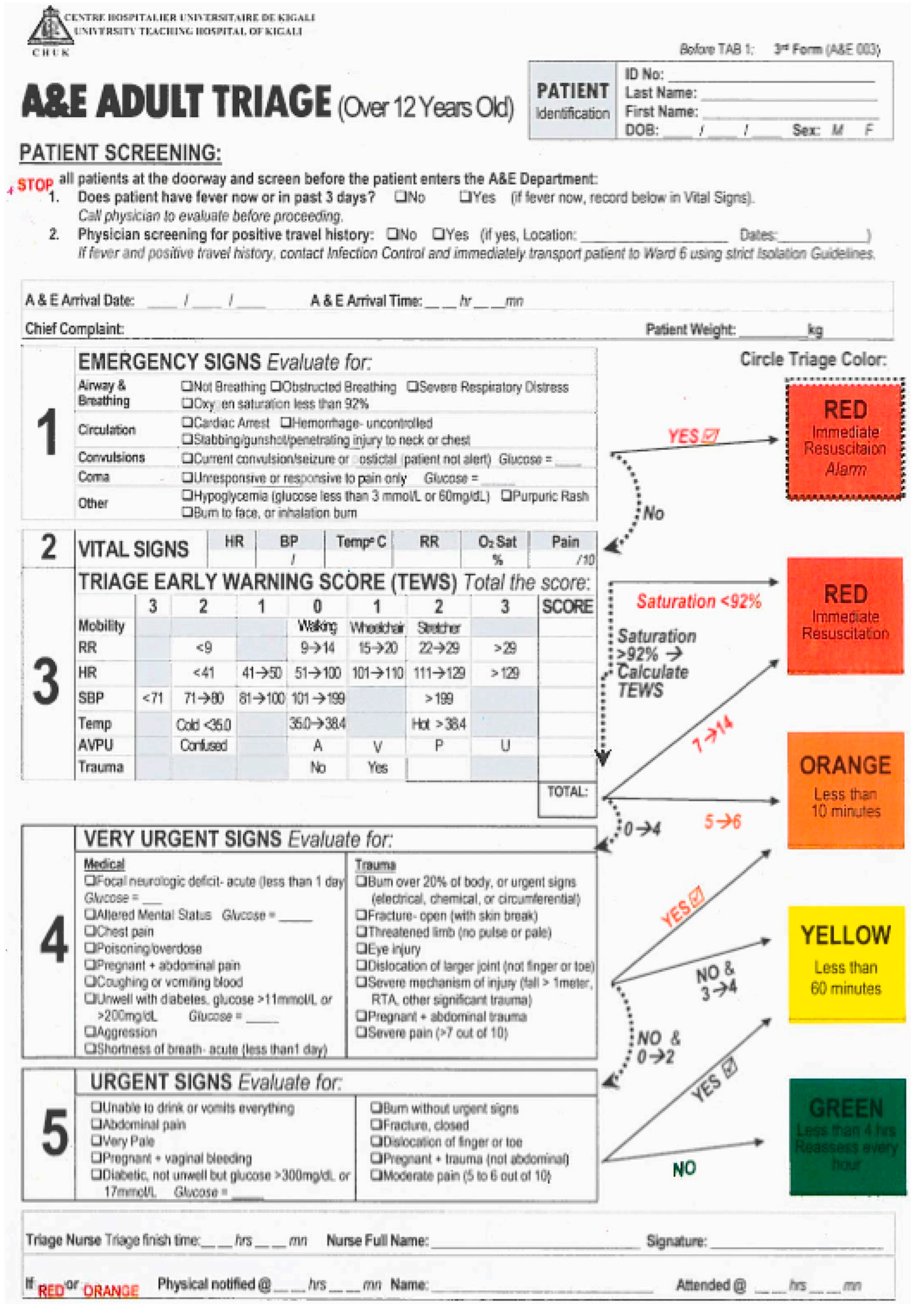

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CHUK

Before TAB 1: 3rd Form (A&E 003)

A&E ADULT TRIAGE (Over 12 Years Old)

PATIENT Identification — ID No: / Last Name: / First Name: / DOB: __ / __ / __ Sex: M F

PATIENT SCREENING:

STOP all patients at the doorway and screen before the patient enters the A&E Department:

1. Does patient have fever now or in past 3 days? ❑No ❑Yes (if fever now, record below in Vital Signs).
   Call physician to evaluate before proceeding.
2. Physician screening for positive travel history: ❑No ❑Yes (if yes, Location: ______ Dates: ______)
   If fever and positive travel history, contact Infection Control and immediately transport patient to Ward 6 using strict Isolation Guidelines.

A & E Arrival Date: __ / __ / __ A & E Arrival Time: __ hr __ mn

Chief Complaint: Patient Weight: ____ kg

Circle Triage Color:

1 EMERGENCY SIGNS *Evaluate for:*

Airway & Breathing	❑Not Breathing ❑Obstructed Breathing ❑Severe Respiratory Distress ❑Oxygen saturation less than 92%
Circulation	❑Cardiac Arrest ❑Hemorrhage- uncontrolled ❑Stabbing/gunshot/penetrating injury to neck or chest
Convulsions	❑Current convulsion/seizure or postictal (patient not alert) Glucose = ____
Coma	❑Unresponsive or responsive to pain only Glucose = ____
Other	❑Hypoglycemia (glucose less than 3 mmol/L or 60mg/dL) ❑Purpuric Rash ❑Burn to face, or inhalation burn

YES ☑ → RED Immediate Resuscitation Alarm

No ↓

2 VITAL SIGNS

HR	BP	Temp° C	RR	O2 Sat	Pain
	/			%	/10

3 TRIAGE EARLY WARNING SCORE (TEWS) *Total the score:*

	3	2	1	0	1	2	3	SCORE
Mobility				Walking	Wheelchair	Stretcher		
RR		<9		9→14	15→20	22→29	>29	
HR		<41	41→50	51→100	101→110	111→129	>129	
SBP	<71	71→80	81→100	101→199		>199		
Temp		Cold <35.0		35.0→38.4		Hot >38.4		
AVPU		Confused		A	V	P	U	
Trauma				No	Yes			
							TOTAL:	

Saturation <92% → RED Immediate Resuscitation

Saturation >92% → Calculate TEWS

7→14 → RED; 5→6 → ORANGE Less than 10 minutes; 0→4 ↓

4 VERY URGENT SIGNS *Evaluate for:*

Medical	Trauma
❑Focal neurologic deficit- acute (less than 1 day) Glucose = ____	❑Burn over 20% of body, or urgent signs (electrical, chemical, or circumferential)
❑Altered Mental Status Glucose = ____	❑Fracture- open (with skin break)
❑Chest pain	❑Threatened limb (no pulse or pale)
❑Poisoning/overdose	❑Eye injury
❑Pregnant + abdominal pain	❑Dislocation of larger joint (not finger or toe)
❑Coughing or vomiting blood	❑Severe mechanism of injury (fall > 1meter, RTA, other significant trauma)
❑Unwell with diabetes, glucose >11mmol/L or >200mg/dL Glucose = ____	❑Pregnant + abdominal trauma
❑Aggression	❑Severe pain (>7 out of 10)
❑Shortness of breath- acute (less than1 day)	

YES ☑ → ORANGE; NO & 3→4 → YELLOW Less than 60 minutes; NO & 0→2 ↓

5 URGENT SIGNS *Evaluate for:*

❑Unable to drink or vomits everything	❑Burn without urgent signs
❑Abdominal pain	❑Fracture, closed
❑Very Pale	❑Dislocation of finger or toe
❑Pregnant + vaginal bleeding	❑Pregnant + trauma (not abdominal)
❑Diabetic, not unwell but glucose >300mg/dL or 17mmol/L Glucose = ____	❑Moderate pain (5 to 6 out of 10)

YES ☑ → YELLOW; NO → GREEN Less than 4 hrs Reassess every hour

Triage Nurse Triage finish time: __ hrs __ mn Nurse Full Name: ______ Signature: ______

If RED or ORANGE Physical notified @ __ hrs __ mn Name: ______ Attended @ __ hrs __ mn

Fig. 1. Adult triage form.

absence of triage systems is associated with longer times to provider evaluation, poorer assessments of clinical risk and increased morbidity and mortality [8].

Many triage systems exist, however no single system is universal or clinically superior [9–11]. High income countries (HICs) have implemented triage systems such as the Australian Triage Scale (ATS), Canadian Triage and Acuity Scale (CTAS), Manchester Triage System (MTS), Emergency Severity Index (ESI), and the Early Warning Score (EWS) [12,13]. HIC-developed triage systems are of lower utility in low- and-middle income countries (LMICs) for reasons such as resource limitations, culture barriers and region specific pathophysiologies [14–16]. LMICs have created variations and unique triage scores to fit their healthcare needs including local disease burdens and resource availability [17,18].

The South African Triage Scale (SATS) was created as a triage system contextually appropriate for Africa [5,19]. The SATS has been shown to have validity and reliability as a triage tool in resource-limited settings [20,21], and multiple countries in Africa have adapted the SATS to fit their setting specific needs [22–24]. Rwandan emergency providers working in conjunction with international physician partners (within the sidHARTe and Human Resources for Health Program) developed a locally modified South African Triage Scale (mSATS) which was implemented at the University Teaching Hospital-Kigali (UTH-K) in 2013.

Triage systems have not been well-studied in Rwanda, a country which is experiencing rapid development and increased demand for emergency care [25–28]. To test the reliability of an emergency triage system, it is important to apply the tool in the clinical environment where it will be utilized [14,20]. The current study aimed to evaluate the utility of the mSATS tool implemented at a tertiary hospital in Rwanda.

Methods

The study was carried out at UTH-K, the primary public referral hospital in Kigali, Rwanda. The facility is an urban, tertiary-care institution with approximately 40 EC and 500 inpatient beds with access to specialty services, laboratory medicine and radiologic capabilities. The study site serves approximately 11 million Rwandans as the primary public referral center for all seriously ill patients. UTH-K has a dedicated EC with multiple medical and surgical specialists and subspecialists available for consultation and is home to the country's sole emergency medicine (EM) training program. UTH-K implemented the mSATS as their triage assessment system in April 2013. This retrospective cohort study aims to evaluate whether the implemented triage system provides clinically relevant information on patient disposition and mortality in the Rwandan context. The study received approval from the University of Rwanda College of Medicine and Health Science Institutional Review Board (No. 282/CMHS IRB/2017) and the University Teaching Hospital of Kigali's Ethics Committee (reference number EC/CHUK/378/2017). The data obtained was retrospective and de-identified.

All patients aged 15 years or older presenting to the UTH-K EC during the time periods August 2015–July 2016 were eligible for inclusion in the study. Cases less than 15 years of age are generally treated in a pediatric care area unless they are critically ill. Thus, patients under 15 years of age were not included so as not to introduce bias. Cases without an identifiable medical record or those lacking EC record documentation for the visit of interest were excluded.

mSATS triage tool and clinical procedures

The SATS has three components. The Triage Early Warning Score (TEWS), which includes, trauma patients [4,5], was chosen as one component of the system with its physiologic assessment and symptom based numeric scale. The other two components to SATS include a discriminator list and a color category. Discriminators are core to the decision-making process and include: mechanism of injury, presentation, pain, and senior healthcare professional's discretion [2,29–31]. The color categories are red, orange, yellow, green, and blue. Red patients require resuscitation and are physiologically unstable patients. Orange patients are those with potentially unstable physiology or life/limb threatening pathology. Yellow patients are physiologically stable with reasonably serious medical or trauma conditions. Green patients have minor injuries or illnesses. Blue patients are clearly dead [5]. As illustrated in Fig. 1, the mSATS includes 3 components, similar to SATS, including a TEWS score, discriminators (called "signs") and a color category. The discriminators include "emergency signs" including airway and breathing, circulation, convulsions, coma, hypoglycemia, purpuric rash, facial burn or inhalation burn injury as well as "very urgent signs" and "urgent signs". The UTH-K triage system is a 5-level instrument, but does not include the SATS blue color category and divides the red color category into two sections for a more rapid assessment point to initiate resuscitation prior to calculation of a more in depth risk assessment score that uses aspects of the presentation and vital signs. The red color categories are: red (with alarm) or emergency signs, red (without alarm), orange, yellow, and green. Red (with alarm) patients require immediate resuscitation with disorders of the airway, breathing, and circulation, or convulsions, coma, hypoglycemia, purpuric rash, and burn. Red (without alarm) patients require immediate resuscitation and are categorized as having an oxygen saturation of less than 92% or a TEWS score of 7–14. Orange patients have a TEWS score of 5–6 or a "very urgent sign" that warrants care in less than 10 min. Yellow patients have a TEWS score of 3–4 or "urgent signs" that warrant care in less than 60 min. Green patients have a TEWS score of 0–2 with no "urgent signs" and require care within 4 h but with hourly assessments by triage personnel. A physician is immediately notified if a patient is triaged as red or orange. Nurses with triage training perform an evaluation for every patient entering the EC (Fig. 1).

Data were initially collected from archived hard-copy charts and then extracted and entered into a REDCap (Research Electronic Data Capture) electronic database [32]. Extracted data were entered by protocol-trained study personnel and verified by a trained physician. Double entry of data was performed for 10% of patients. Cases were identified and data were queried from institutional records via protocolised methods, using a multipoint composite index generated through an electronic hospital database in which all cases during each month of the study period were identified. Subsequently, cases were coded with a unique identification number and were sampled at random until a sufficient number of records meeting inclusion were identified (range 135–165 records per month). This data collection methodology has been previously described and employed in research in Rwanda [27,33]. Data procedures conformed to quality practices for chart review research in emergency medicine [34]. Study data included information on triage data, demographics, case type including injury versus medical, EC disposition and mortality. Diagnoses were based on those documented by providers at time of last healthcare contact either from the EC or from the inpatient setting for cases that were admitted. Any ambiguous elements were coded as missing.

Descriptive and inferential analyses were undertaken for the overall cohort of randomly sampled cases and stratified by case type. Variables were described using frequencies with percentages or medians with associated interquartile ranges (IQR). Characteristics and outcomes based on mSATS categorization were evaluated. The outcomes of interest were need for admission to an inpatient service from the emergency department and overall hospital mortality. Logistic regression models yielding odds ratios (OR) with associated 95% confidence intervals (CI) were used to quantify magnitudes of effect for the outcome of interest. As the mSATS categories incorporate and controls for a broad range of variables and due to the aim of evaluating the utility of the mSATS tool specifically, further statistical adjustment was not undertaken. Analyses were performed using STATA version 15.0 (StataCorp;College Station, Texas, USA).

Results

A total of 1438 EC cases were included in the study. The majority of triaged EC patients were male (61.8%) and in the 15–44 year-old age range with a median age of 35 years. Overall 808 patients (56.7%) presented to the EC for injuries versus 617 (43.3%) who presented for medical problems. In thirteen cases, there was no case type designated (Table 1).

Hospital admission occurred for 892 (62.0%) of patients. Of the admitted patients, 539 (60.4%) were admitted to surgical wards (acute care surgery, neurosurgery, orthopedic surgery, otolaryngology, stomatology or ophthalmology) and 319 (35.8%) were admitted to the internal medicine service. Thirty patients (3.4%) required admission to the high-dependency or intensive care unit. The admitting service was not documented for 4 patients (0.5%). Two hundred and eighty-eight patients (20%) were discharged home, while 14 patients (1%) were transferred to area district hospitals for further care. Five patients (4%) eloped from the EC. The disposition from the EC was not documented for 223 patients (15.5%) (Table 1).

Among the triage color categories, the majority of patients were categorized as yellow. In the overall cohort studied, 103 patients (8.9%) were categorized to triage color green, 471 patients (41.1%) were categorized to triage color yellow, 440 patients (38.4%) were categorized to triage color orange, 106 patients (9.3%) were categorized to triage color red (no alarms), and 26 patients (2.3%) were categorized to triage color red with alarm. No triage color category was recorded for 292 patient charts (Table 2).

For the overall population studied, the likelihood of admission significantly increased with increasing triage color category ranging from an OR of 2.24 (Yellow, $p = .01$) to 4.1 (red with alarms,

Table 1
Patient demographics and disposition from the EC for the general population

Age	n (%)
15–44	940 (65.4%)
45–64	295 (20.5%)
≥65	196 (13.6%)
Age not documented	7 (0.5%)
Total	1438 (100%)
Median age (IQR)	35 (26, 53)
Gender	**n (%)**
Male	889 (61.8%)
Female	548 (38.1%)
Gender not documented	1 (0.1%)
Total	1438 (100%)
Case type	**n (%)**
Injury	808 (56.7%)
Medical	617 (43.3)
Type not documented	13 (<0.1%)
Total	1438 (100%)
Disposition from the EC	**n (%)**
Admitted n = 892/1438	
Surgery or surgical subspecialty ward admission	539 (37.5%)
Internal medicine ward admission	319 (22.2%)
Intensive care unit or step-down unit admission	30 (2.1%)
Specialty admission not documented	4 (<0.1%)
Discharged n = 302/1438	
Home	288 (20.0%)
Referred to a district hospital	14 (<0.1%)
Died in the ED	16 (1.1%)
Eloped	5 (<0.1%)
Disposition not documented	223 (15.5%)
Total	1438 (100%)

p < .001). When stratified by medical versus trauma patients, the likelihood of admission for medical patients had statistically significant ORs ranging from 3.61 (Yellow, p < .001) to 7.80 (Red with alarms, p = .01). For trauma patients, the likelihood of admission based on triage category was not statistically significant with p values >.05 for all categories (excluding red with no alarms p < .028) (Table 3).

Overall mortality outcomes were known for 1215 cases of which there were 124 deaths (10.2%) with 16 (1.3%) occurring in the EC. Overall case mortality prevalence increased with triage illness severity with the red with alarm category having the highest mortality (7.7%, OR 18.91) and the green category having no deaths. When stratified by medical versus trauma patients, the mortality OR for medical patients increased with triage category except for red with alarm (yellow OR 5.55, orange OR 10.91, red no alarm OR 16.36, red with alarm OR 12.27). The mortality ORs for trauma patients were not significant (Table 4).

Discussion

This study assessed the utility of a locally-modified SATS system in an EC population in Rwanda. For the overall sample population, we found that a higher triage color category was significantly associated with the increased likelihood of admission to the hospital. UTH-K's admission rate is high (62.0%), possibly related to its status as Rwanda's main tertiary referral hospital.

For trauma patients, the mSATS scoring system did not provide useful clinical differentiation for admission, suggesting that an alternative trauma-specific triage tool may be superior if used in the setting studied. In ECs that concurrently attend to trauma and medical emergencies, critical patients need to be effectively identified [4,35]. Trauma patients are often prioritized because of the physical appearance of their injuries, while medical patients may have to wait for long periods before being evaluated even though they may have similar or even greater burdens of illness and mortality risks. Trauma patients are generally healthy and as such may have greater physiologic reserve [2]. For this reason, some ECs use a different scoring system for trauma versus medical patients. This strategy may be beneficial in the setting currently studied at the UTH-K, and in other similar LMIC EC settings in which there are large numbers of trauma patients presenting for emergency care. Future prospective research evaluating the mSATS versus other commonly used trauma triage tools such as the Revised Trauma Score are needed to address this question.

Our study illustrates how stratified mortality likelihoods can be ascertained from the mSATS triage score information as overall mortality increased with increasing triage color category. Early identification of EC cases with a high mortality can guide expeditious treatment. Overall mortality in this study was 10.2% with 1.3% of those patients dying in the EC. When the data is further evaluated for medical versus trauma patients, the odds of death increased with increasing triage level for medical patients, however the findings were not stable for trauma patients similar to the outcome of admission. This reiterates the importance and need for further studies to identify a triage system that discriminates trauma patients at high risk of death in LMICs similar to the one studied here.

Globally, injuries are the leading cause of death for individuals less than 44 years of age and result in a major cost burden for healthcare systems [1,3]. In LMICs, almost half of the injury related deaths and a third of the disability from injuries could be addressed by emergency care systems [5,7,36]. Triage systems have been implemented in other countries in East Africa outside of Rwanda. Tanzania, Kenya and

Table 2
Emergency care disposition across mSATS categories

mSATS category	Admitted n (%)	Discharged n (%)	Referred to district hospital n (%)	Died n (%)	Eloped n (%)	Unknown n (%)
Red (with alarms) n = 26	18 (69.2%)	3 (11.5%)	0 (0.0%)	2 (7.7%)	0 (0.0%)	3 (11.5%)
Red (no alarms) n = 106	81 (76.4%)	12 (11.3%)	3 (2.8%)	7 (6.6%)	0 (0.0%)	3 (2.8%)
Orange n = 440	296 (67.3%)	95 (21.6%)	5 (1.1%)	5 (1.1%)	0 (0.0%)	39 (8.9%)
Yellow n = 471	243 (51.6%)	111 (23.6%)	6 (1.3%)	1 (0.2%)	4 (0.84%)	106 (22.5%)
Green n = 103	28 (27.2%)	31 (30.1%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	43 (41.7%)
Total n = 1146	648 (58.1%)	252 (22.3%)	14 (1.2%)	15 (1.3%)	5 (0.4%)	194 (17.2%)

Table 3
Likelihoods for admission and mortality outcomes based on mSATS categorization

mSATS category	Admission outcome					
	Overall		Trauma cases		Medical cases	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Green	Reference		Reference		Reference	
Yellow	2.24 (1.3–3.9)	.01	0.84 (0.27–2.55)	.75	3.61 (1.88–6.92)	<.001
Orange	3.22 (1.9–5.6)	<.001	1.62 (0.54–4.87)	.39	4.90 (2.5–9.6)	<.001
Red (no alarm)	4.20 (2.1–8.4)	<.001	4.63 (1.18–18.11)	.01	3.58 (1.58–8.09)	<.001
Red (with alarm)	4.10 (1.4–3.9)	<.001	1.50 (0.26–8.58)	.65	7.80 (1.56–38.88)	.01

mSATS category	Mortality outcome					
	Overall		Trauma cases		Medical cases	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Green	Reference		Reference		Reference	
Yellow	4.71 (0.63–35.35)	.13	0.01 (0–0.1)	<.001	5.55 (0.73–41.92)	.10
Orange	7.27 (0.98–53.79)	.05	0.03 (0.01–0.14)	<.001	10.91 (1.46–81.54)	.02
Red (no alarm)	18.91 (2.49–143.50)	<.01	0.33 (0.7–1.50)	.15	16.36 (2.08–128.70)	.01
Red (with alarm)	25.81 (2.96–225.30	<.001	No data		12.27 (1.16–129.6)	.04

Table 4
Medical versus trauma by triage category and mortality

Medical vs trauma triage category	Trauma n (%)	Medical n (%)	Total n (%)
Green	14 (2%)	46 (5%)	60 (6%)
Yellow	128 (13%)	237 (25%)	365 (38%)
Orange	196 (21%)	205 (22%)	401 (42%)
Red (no alarm)	43 (5%)	60 (6%)	103 (11%)
Red (with alarm)	9 (1%)	14 (2%)	23 (2%)
Total	390 (41%)	562 (59%)	952

Medical vs trauma mortality	Trauma n (%)	Medical n (%)	Total n (%)
Green	0 (0%)	1 (<1)	1 (<1%)
Yellow	1 (<1%)	26 (25%)	27 (26%)
Orange	4 (4%)	40 (38%)	44 (42%)
Red (no alarm)	9 (9%)	16 (15%)	25 (24%)
Red (with alarm)	4 (4%)	3 (3%)	7 (7%)
Total	18 (17%)	86 (83%)	104 (100%)

Ethiopia have implemented the SATS tool and Uganda has developed the Kampala Trauma Score (KTS). The KTS was developed as a simplified composite of Revised Trauma Score (RTS) and Trauma Injury Severity Score (TRISS) for use in low-resource settings as it requires minimal data collection and recording [30]. Studies done in Cameroon and Ghana compared KTS to multiple trauma scoring systems from the developed world, including the Injury Severity Score (ISS), RTS and the TRISS and revealed the KTS is an effective predictor of patient outcomes achieving statistical performance comparable to the other scoring systems [30,37]. Given this prior evidence, the KTS may be an appropriate tool to use in the Rwanda emergency care context to overcome the breakdown of the mSATS tool observed in the sub-population of trauma patients. A direct prospective comparison would likely result in important data to guide the implementation of a better triage system to improve emergency care in Rwanda.

Limitations

A limitation of this study was lack of documentation in some of the medical records and associated missing data. The EC disposition was not documented in a number of cases across all triage categories, however as the cases were selected at random it is unlikely that systematic error existed which would bias the observed findings. Additionally, for some of the sub-categorizations of interest, there were limited numbers of cases and this impacted the precision around select likelihood estimates for the outcomes of admission and mortality. Although there were limited samples in sub-categorizations the large overall sample provides important information on triage utility in the study setting. We do not have information about the type of triage training that nurses at UTH-K have to enable them to effectively triage patients using the mSATS tool. A study in Uganda reveals that barriers to effective triage include lack of training which can cause inaccurate triage decisions [38]. We did not assess the accuracy of the nursing mSATS triage evaluations of patients included in this study. Finally, our data was extracted from a single academic training site with a relatively high-level of resources and emergency care experience and as such the generalization to less well-resourced practice environments is not certain.

Conclusions

This is the first study in Rwanda analyzing an implemented EC-based triage system (mSATS). Among all patients presenting for care, the UTH-K mSATS system provided useful clinical guidance on the likelihood of need for hospital admission and mortality, however in a sub-group analysis of trauma patients this utility was not maintained. Further prospective study of triage systems, especially focused on trauma patients, will help guide improvements in the emergency care system in Rwanda and potentially other similar practice settings.

Dissemination of results

Results from this study were shared at the African Conference on Emergency Medicine, November 2018 in Kigali, Rwanda (poster presentation by the first author). Results from this study were also presented for "Research Day" for the Department of Anesthesia and Critical Care at the University Teaching Hospital, Kigali in April, 2018 (presented by the first author).

Authors' contributions

Authors contributed as follows 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: CU and MG contributed 20% each; ARA and ER 15% each; EC, ZM, NK, JCB 5% each; and ACL 10%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declare no conflict of interest.

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