An adapted triage tool (ETAT) at Red Cross War Memorial Children's Hospital Medical Emergency Unit, Cape Town: An evaluation

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Objective. To evaluate the efficacy of an adapted Emergency Triage Assessment and Treatment (ETAT) tool at a children's hospital.
Design. A two-armed descriptive study.
Setting. Red Cross War Memorial Children's Hospital, Cape Town, South Africa.
Methods. Triage data on 1 309 children from October 2007 and July 2009 were analysed. The number of children in each triage category red (emergency), orange (urgent or priority) and green (non-urgent)) and their disposal were evaluated.
Results. *The October 2007 series:* 902 children aged 5 days - 15 years were evaluated. Their median age was 20 (interquartile range (IQR) 7 - 50) months, and 58.8% (*n*=530) were triaged green, 37.5% (*n*=338) orange and 3.8% (*n*=34) red. Over 90% of children in the green category were discharged (478/530), while 32.5% of children triaged orange (110/338) and 52.9% of children triaged red (18/34) were admitted. There was a significant increase in admission rate for each triage colour change from green through orange to red after adjustment for age category (risk ratio (RR) 2.6; 95% confidence interval (CI) 2.2 - 3.1).
The July 2009 cohort: 407 children with a median age of 22 months (IQR 7 - 53 months) were enrolled. Twelve children (2.9%) were triaged red, 187 (45.9%) orange and 208 (51.1%) green. A quarter (101/407) of the children triaged were admitted: 91.7% (11/12) from the red category and 36.9% (69/187) from the orange category were admitted, while 89.9% of children in the green category (187/208) were discharged. After adjusting for age category, admissions increased by more than 300% for every change in triage acuity (RR 3.2; 95% CI 2.5 - 4.1).
Conclusions. The adapted ETAT process may serve as a reliable triage tool for busy paediatric medical emergency units in resource-constrained countries and could be evaluated further in community emergency settings.

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Triage in an emergency setting allows rapid identification of children in genuine need of urgent or emergency attention from among the larger number presenting to the unit. In the developing world it has been recognised that lack of triage is a major factor contributing to the poor quality of emergency care of children.[1]

A triage system introduced and developed by the Cape Triage Group, known as the South African Triage Score (SATS, 2006),[2] is a comprehensive triage system comprising a rapid clinical signs check plus a composite physiological score, the Triage Early Warning Score (TEWS). The TEWS relies on a number of physiological variables including heart rate, respiratory rate, temperature, level of consciousness, mobility, and the presence or absence of trauma in order to assign a triage category to an adult or child arriving at an emergency centre. It has been used with success in community health centre emergency departments in the Western Cape, but in children these physiological variables may be influenced by crying and lack of co-operation and may be unreliable, and impractical in terms of time taken to measure them, when applied in high-caseload paediatric settings.

The Emergency Triage Assessment and Treatment (ETAT) package was developed by the World Health Organization (WHO) specifically to address the problem of poor triage and emergency care of children in the developing world.[3] It is designed for use by health workers in busy, under-staffed and under-resourced settings and has been shown to reduce inpatient case mortality.[4] ETAT Module One allows for triage using a systematic 'A-B-C-D' of clinical signs and a priority features approach. It has been validated in several clinical settings.[5,6] Healthcare staff are trained to recognise life-threatening problems by identifying the key emergency signs in this 'A-B-C-D' approach, where A and B denote Airway and Breathing problems, C indicates Circulation, Coma and Convulsions, and D denotes severe Dehydration (diarrhoea). These emergency and priority features are grouped into a 'red' category indicating the need for immediate care and an 'orange' category for children with urgent

problems who should be directed to the 'priority' queue, while those with non-urgent problems are coded 'green' and can wait to be seen. Table 1 shows the adapted version of the ETAT categories, acuity and destination that was used at Red Cross War Memorial Children's Hospital (RCH) in Cape Town.

The Medical Emergency Unit (MEU) at RCH sees more than 40 000 children a year. It was believed that an ETAT-based process would be more appropriate than the 2006 SATS for this setting because the time taken to measure vital signs and calculate TEWS, and the difficulties involved in measuring vital signs accurately, were considered to be impractical for a high-volume emergency setting. Through a consensus process, and using the same colour categories for triage groups, the ETAT system was adapted to include weight and temperature measurement for all children, with oxygen saturation measurement when any respiratory distress was evident. It reflected the health problems most commonly seen.

In the MEU, children with emergency signs are immediately taken to the resuscitation room, where vital signs are measured while emergency treatment is concurrently administered. The weight of each child is estimated from standard formulae until formal weighing can be done once the child is stable. Children requiring acute trauma care are seen in a unit separate from the MEU, the number of acute surgical referrals coming through the MEU constituting less than 10% of the caseload.

The aim of this study was to evaluate the ability of the adapted ETAT tool to stratify children correctly by acuity level in this setting.

Methods

The ETAT-based triage system was introduced into the MEU in October 2007 after the nursing staff had been formally trained in its use. Triage forms were completed in duplicate by the nurses who applied the triage tool; the appropriate boxes on the form were then ticked, and the patient was assigned a triage colour. Copies of triage forms were collected daily and stored in a secure area by the principal investigator.

Study design and sampling

Two samples of patients triaged in the MEU at RCH were gathered.

1. The first sample was compiled using triage data on 1 000 consecutive patients from the beginning of October 2007. Patients admitted directly into any of the wards other than via the MEU, and those attending RCH for booked visits or trauma room consultation, were not eligible for inclusion. The aims of this arm of the study were to define the proportions of each triage category in the MEU and to measure the efficacy of the triage process in correctly identifying the sickest patients. Of the 1 000 forms, 98 were excluded because of insufficient clinical information, leaving 902 forms for analysis.

2. A second sample of 460 children was collected prospectively during one week in July 2009, by which time the triage system had become routine. The aim of this study was the same as for the first arm. The sample size of 200 was computed using the proportions in each triage category from the first study to ensure statistical power to distinguish true differences between admission rates in the three groups. In this group 53 forms were excluded because of insufficient clinical information.

Outcome measures to assess the efficacy of the triage process included the proportion of children admitted to hospital in each colour category, admissions to the intensive care unit (ICU), and deaths within 24 hours of triage. Admission and death data were obtained from the hospital's computer system. Triage information and hospital data were matched by folder number, name or date of birth.

Table 1. Triage categories, acuity and destination at Red Cross War Memorial Children's Hospital using the adapted ETAT triage tool

Presenting problem	Required acuity intervention	Triage category	Destination after triage
Emergency signs – any one of: Airway and breathing problems (apnoea, obstructed airway, choking, cyanosis, severe respiratory distress) Circulation: shock Coma Convulsions Dehydration (severe) Other (e.g. hypoglycaemia, purpuric rash)	Requires *immediate* care	Red	Medical Emergency Unit
Priority signs (3TPR MOB)* Temperature (>38ºC) Tiny infant (<2 months)† Trauma (severe)/urgent surgical Pain (severe) Pallor (severe anaemia, Hb <5 g/dl) Poisoning Respiratory distress ('some') Referral urgent from another facility Restless/irritable/lethargic Malnutrition – visible severe wasting Oedematous malnutrition Burns (major)	Requires *urgent* care	Orange	Acute-care area
Any other non-urgent problem	Can *wait* in the queue	Green	Medical outpatients

*3TPR MOB is the acronym for the individual ETAT priority signs – a child with any of these signs would be considered for urgent care.
†This age group often presents with nonspecific symptoms and has the highest mortality in developing countries.
Hb = haemoglobin.

The study was approved by the Research Ethics Committee of the University of Cape Town and the Management of RCH (HREC REF: 447/2010).

Procedures

1. The 2007 case series: At the start of the new triaging process, triage form collection boxes were placed in the acute care, medical emergency and medical outpatient clinic rooms; the nurses and medical officers attending to patients completed the triage forms, which the principal investigator collected on a daily basis and stored in boxes in a locked office. The forms were piled in groups of the day's takings and stacked into two boxes, and the top 1 000 consecutive forms were selected for analysis. Information on age, gender, time of triage, triage category, triage symptom at presentation and disposal was recorded and entered into a Microsoft Office Excel database by one study team member.

2. The 2009 cohort: A copy of each triage form was collected during one week in July 2009 on the day the child was seen in the MEU and stored in a secure office. Information gathered prospectively included the following variables: gender, age, time of triage, triage category, and triage symptom on presentation; in addition, disposal destination was documented. The following day, one researcher determined whether the child had been admitted to hospital or had died.

Statistical analysis

Data were collated using information from the adapted ETAT triage forms and analysed using the STATA statistical package (Stata Corp, Version 11). Descriptive analysis using medians with interquartile ranges (IQRs) were used to summarise age distributions. Proportions were depicted as percentages for categorical variables. A chi-square test was used to test for strength of association between categorical variables. Risk ratios (RRs) with 95% confidence intervals (CIs) were used to estimate the effect of triage on outcome (admission). A modified general linear model using Poisson regression was used to estimate adjusted RRs with CIs. A significance level of $p<0.05$ was used for all analyses.

Results

The 2007 analysis

Description

Nine hundred and two children had sufficient information to be included in the analysis. Their ages ranged from 5 days to 15 years (median 20 (IQR 7 - 50) months). Information on gender was recorded for 897 of the children: 53.7% (482) were male. Of the children 58.8% (530) were triaged green, 37.5% (338) orange and 3.8% (34) red. The distribution of triage codes according to age category is set out in Table 2.

A total of 180 children (20.0%) were admitted, 9.8% (52), 32.5% (110) and 52.9% (18) of the green, orange and red triage categories, respectively.

Two deaths were identified among the study children. Both of those who died were triaged red – one died in the MEU despite resuscitation efforts, and the other in the ICU within 24 hours of admission.

Analysis

There was a strong association between age category and triage colour (χ^2 $p<0.001$), as well as between age category and the outcome of interest (χ^2 $p<0.001$). The analysis was stratified by age category to test the intra-stratum association between triage colour and admission. With the exception of the <2 months age category, all the other groups showed a statistically significant association between triage colour and admission. The effect of triage on admission is shown in Table 3.

Overall, the trend showed an almost threefold increase in admission rate for each triage colour change from green through orange to red after adjustment for age category (RR 2.6; 95% CI 2.2 - 3.1). No association was found between the gender of the children and either triage score or chance of admission (χ^2 $p=0.7$ and χ^2 $p=0.5$, respectively).

The 2009 analysis

Description

In this arm of the study, 407 children had sufficient information to be analysed. The median age was 22 (IQR 7 - 53) months, with ages ranging from 11 days to 15 years. Of those whose gender was recorded, 55.0% (224) were male. The distribution of triage categories

Table 2. Frequency of triage colour according to age category in the two study periods, 2007 and 2009

	Green *n* (%)	Orange *n* (%)	Red *n* (%)	Total *N*
2007				
<2 months	4 (0.8)	50 (14.8)	7 (20.6)	61 (6.8)
2 - 12 months	124 (23.4)	139 (41.1)	17 (50.0)	280 (31.0)
1 - 5 years	261 (49.3)	118 (34.9)	4 (11.8)	383 (42.5)
>5 years	141 (26.6)	31 (9.2)	6 (17.7)	178 (19.7)
Total	530 (100)	338 (100)	34 (100)	902 (100)
2009				
<2 months	4 (1.9)	34 (18.2)	2 (16.7)	40 (9.8)
2 - 12 months	39 (19.2)	54 (28.9)	5 (41.7)	99 (24.3)
1 - 5 years	101 (49.5)	73 (39.0)	5 (41.7)	181 (44.5)
>5 years	59 (29.3)	26 (13.9)	0 (0.0)	87 (21.4)
Total	208 (100)	187 (100)	12 (100)	407 (100)

Table 3. Relative risk of admission according to triage group and age category in the two study periods, 2007 and 2009

	2007 (*N*=902)		2009 (*N*=407)	
	n* (%)	**RR (CI)**	***n* (%)***	**RR (CI)**
Cumulative				
Green	52 (9.8)	1	21 (10.1)	1
Orange	110 (32.5)	3.2 (2.3 - 4.5)†	69 (36.9)	3.7 (2.3 - 5.8)†
Red	18 (52.9)	5.2 (3.4 - 8.0)†	11 (91.7)	9.1 (5.8 - 14.5)†
<2 months				
Green	1 (25.0)	1	1 (25.0)	1
Orange	13 (26.0)	1.0 (0.2 - 6.1)	14 (41.2)	1.6 (0.3 - 9.6)
Red	3 (42.9)	1.7 (0.3 - 11.7)	2 (100.0)	4.0 (0.7 - 22.3)
2 - 12 months				
Green	18 (14.5)	1	3 (7.5)	1
Orange	48 (34.5)	2.4 (1.5 - 3.9)	17 (31.5)	4.2 (1.3 - 13.2)
Red	10 (58.8)	4.1 (2.3 - 7.3)	4 (80.0)	10.7 (3.3 - 34.7)
1 - 5 years				
Green	24 (9.2)	1	12 (11.7)	1
Orange	37 (31.4)	3.4 (2.1 - 5.4)	27 (37.0)	3.2 (1.7 - 5.9)
Red	2 (50.0)	5.4 (1.9 - 15.6)	5 (100.0)	8.6 (5.0 - 14.6)
>5 years				
Green	9 (6.4)	1	5 (8.2)	1
Orange	12 (38.7)	6.1 (2.8 - 13.2)	11 (42.3)	5.2 (2.0 - 13.5)
Red	3 (50.0)	7.8 (2.8 - 21.8)	0 (0.0)	-

RR (CI) = risk ratio (95% confidence interval).
*Number and percentage admitted per triage group per stratum.
†RR adjusted for age category.

was 51.1% (208) green, 45.9% (187) orange and 2.9% (12) red, and 101 children were admitted: 10.1% (21), 36.9% (69) and 91.7% (11) of the green, orange and red triage categories, respectively. There were no deaths in the MEU and none of the study children was admitted to the ICU. Among the admitted patients, there was one death – this child was triaged orange by the nurses in the MEU and, having been upgraded to the red category by doctors in the triage area, was admitted to one of the high-care units and died at 48 hours of complications of bacterial meningitis.

Analysis

Age category and triage category showed a strong association (χ^2 p<0.001), as did age category and admission (χ^2 p=0.03). Analysis of the association between triage colour and admission stratified by age category showed a statistically significant effect in three out of the four age categories (Table 3). After adjusting for age category, there was an over 300% increase in admissions for every change in triage acuity (RR 3.2; 95% CI 2.5 - 4.1). Triage score and probability of admission were not affected by gender (χ^2 p=0.4 and χ^2 p=0.6, respectively).

Discussion

Reducing child mortality is a Millennium Development Goal priority (MDG 4), and appropriate triage with timely emergency care is one important means of achieving this. This two-armed descriptive study provides the first information on the efficacy of an ETAT tool in South Africa.

From our data it is apparent that children with different levels of severity of illness arrive at RCH for care. Any triage tool needs to be robust, efficient, and applicable not only to large numbers of children but also to children with different acuities of illness. The spectrum of childhood illnesses seen at this institution is representative of paediatric conditions facing most developing countries, with the exception of malaria. It bears noting that the original tool was developed and validated in Malawi, where malaria is endemic. It therefore can be applied to any malaria-prone sub-Saharan African region.[5] It has also been validated in a malaria-free developing setting and found to perform well.[6]

Up to 90% of children admitted had emergency or priority signs, and more than 90% of children categorised as having non-urgent problems were discharged. In both samples significantly higher proportions of children who were triaged orange and red were admitted compared with those who were triaged green (RR 2.6; 95% CI 2.2 - 3.1 and RR 3.2; 95% CI 2.5 - 4.1, respectively). These results suggest that the adapted ETAT tool assists in identifying children in need of emergency treatment and is safe in our environment. Compared with the 2006 SATS this 'A-B-C-D' triage approach is more user-friendly in high-caseload settings, as time to measure physiological variables is not required. However, it is important to stress that heart rate, respiratory rate and blood pressure measurements contribute valuable physiological information on the impact of a disease process on a child and should not be disregarded, as they are used in paediatric ICU scoring systems to predict mortality.[7]

Other screening tools based on the Integrated Management of Childhood Illness (IMCI) have been employed to identify infants aged <2 months for admission – this age group often presents with nonspecific symptoms and has a high mortality rate, and poor feeding, an elevated temperature, tachypnoea and severe chest in-drawing have been found to be particularly useful criteria in defining severity of illness.[8,9]

In the first month after the introduction of the adapted ETAT tool in the MEU, just under half the children thought to need emergency care (red category) were able to go home. This finding was unexpected and may be explained by the fact that the tool was new to the unit, and the nurses and doctors performing the triage were being overly cautious – it is generally felt that it is better to 'over-triage' than to 'under-triage' and thus avoid under-estimation of the need for emergency care. However, over-triage may become problematic when resources are scarce and caseloads high, the main danger being waste of resources and delay for the sickest children. In the analysis carried out 2 years after introduction of the formal triaging system, more than 90% of children with emergency signs required admission. The under-triage rate remained stable at 10%, comparable to acceptable paediatric trauma norms.[10] The standards for paediatric emergency triage are not well reported, and the models of under- and over-triage are not well defined in the context of non-injured children. The significance of triage is not about deciding who may be discharged home, but who requires treatment first.

Some children are rushed into the emergency room without paper triage. This implies recognition of red category signs by nursing staff, suggesting that the documentation of physiological parameters in the initial triage process for most infants and children is unnecessary and that accurate identification of children in need of emergency care may be achieved by a process that does not rely on these measures in the initial sorting.[11-13] However, it is recognised that some children may appear more well than they in fact are, and their requirement for emergency care be difficult to assess by less experienced nurses and doctors.

The study is limited by inability to provide admission, as well as final diagnoses for all patients, as a number of the triage forms lacked folder numbers. This is explained in part by the hospital policy of not issuing folders to patients who are directed to other facilities following triage. A more detailed review of the number of deaths in each triage category, coupled with a more detailed analysis of the final diagnoses of children who are admitted from each triage group, is needed and will be the focus of further study. Waiting times for children in need of urgent care also need to be reviewed so as to address patient flow and resource allocation.

Nurses can be adequately trained in a simple but highly effective triaging process based on the WHO's ETAT Module One course. It appears that the same 'red flag' signs used in identifying children with serious infection in developed countries bear remarkable, but not surprising, similarity to those promoted by the WHO and have been validated as useful, alongside good clinical acumen and careful regard of parental concerns.[14]

In conclusion, this study suggests that the adapted ETAT tool correctly identifies many critically unwell children and differentiates those most likely to require admission from those likely to be able to go home. For the time being it is confirmed as an appropriate tool for our institution. However, its usefulness in children presenting to district, regional and community emergency settings requires further evaluation.

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