MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DEPARTMENT OF EMERGENCY MEDICINE

COMPARISON OF LOCAL, AUSTRALASIAN, MANCHESTER, CANADIAN AND SOUTH AFRICAN TRIAGE SCALES IN PREDICTING OUTCOMES OF PAEDIATRIC PATIENTS BELOW THE AGE OF 5 YEARS WITH NON-TRAUMATIC MEDICAL COMPLAINTS PRESENTING TO THE MUHIMBILI NATIONAL HOSPITAL, EMERGENCY MEDICINE DEPARTMENT.

By

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A Dissertation submitted in Partial Fulfilment of the Requirement for the Degree of Masters of Medicine in Emergency Medicine of

Muhimbili University of Health and Allied Sciences
October, 2018

COMPARISON OF LOCAL, AUSTRALASIAN, MANCHESTER, CANADIAN AND SOUTH AFRICAN TRIAGE SCALES IN PREDICTING OUTCOMES OF PAEDIATRIC PATIENTS BELOW THE AGE OF 5 YEARS WITH NON-TRAUMATIC MEDICAL COMPLAINTS PRESENTING TO THE MUHIMBILI NATIONAL HOSPITAL, EMERGENCY MEDICINE DEPARTMENT.

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Mmed (Emergency Medicine) Dissertation
Muhimbili University of Health and Allied Sciences
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CERTIFICATION

The undersigned certifies that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation titled, *"**Comparison of Local, Australasian, Manchester, Canadian and South African triage scales in predicting outcomes of paediatric patients below the age of 5 years with non-traumatic medical complaints presenting to the Muhimbili National Hospital at Emergency Medicine Department,"*** in (partial) fulfilment of the Muhimbili university of Health and Allied Sciences' requirement for the degree of Masters of Medicine in Emergency Medicine.

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Date

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(Supervisor)

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Date

DECLARATION AND COPYRIGHT

By submitting this dissertation, I declare that, this entire work contained in here is my own original work, and I have never submitted it and will not be submitted to any institute or University for the purpose of obtaining any other qualification.

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DEDICATION

I would like to dedicate this dissertation to my husband Salehe and my children Balqis, Cyra and Muhammad for their support and patience; without which the entire work would have been impossible. This work is also dedicated to my father, Rafii Jabir and my mother, Fatuma Bakari for their continuous prayers and encouragement. I have no doubt that without their efforts I would not be able to reach this level.

ABSTRACT

Background: Triage of paediatric patients pose a unique challenge due to several factors such as need for special communication skills for providers and difference in response to physiological stressors in paediatric population. While several region's specific validated triage systems exist in the world, Tanzania lack context –appropriate, validated triage tools. Emergency Medicine Department (EMD) at Muhimbili National Hospital (MNH) in Tanzania uses a local triage system based on emergency severity index whose performance in relation to other triage systems is unknown.

Objective: To compare the performance of local, Australasian, Manchester, Canadian and South African triage scale in predicting outcomes below the age of 5 years with non-traumatic medical complaints presenting to the MNH-EMD

Methodology: This was prospective descriptive study of Paediatric patients presenting to the EMD-MNH, from November 2017 to April 2018. Purposively designed data collection form was used to record patient's clinical records, and relevant information for triage purpose according to Local triage system (LTS), Canadian Triage and Acuity Scale (CTAS), Australasian Triage Scale (ATS), Manchester Triage Scale (MTS) and South African Triage Scale (SATS). Descriptive statistics was used to summarise data and analysis was done using counts, frequencies, median and quartiles. Sensitivity, specificity, positive and negative predictive values were calculated to determine the ability of the triage scales in predicting need for admission and 24hrs mortality.

Results: A total of 384 paediatric patients who received triage at EMD-MNH by LTS were studied, their median age was 17 months (Interquartile range 7-36 months) and 211 (54.9%) were male. Using LTS, 67 (17.4%) patients were triaged in emergency (level one), 291 (75.8%) in priority (level 2) and 26 (6.8%) in queue (level 3) categories respectively. Among 67 patients who were triaged level 1 by LTS, only 36 (53.7%) and 25 (37.3%) of them were identified as level one by SATS and MTS respectively. Only 26 (6.8%) were triaged least urgent patients by LTS, SATS identified 21(80.8%) of them as least urgent. There is high sensitivity (80-100%) and specificity (79.9 -80.2%) in predicting mortality while sensitivity for predicting admission was found to be low (27.1- 28.4%) among all triage scales. The urgency to medical care was better predicted by MTS, CTAS, ATS and SATS (all had sensitivity of 100%) compared to LTS (sensitivity 80%).

Conclusion and Recommendation: There is performance variations among LTS and other triage scales in predicting need for admission, mortality and waiting time among Paediatric population. Further studies are needed to determine the reliability and validity of the triage tool suitable in our settings.

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ABBREVIATION OF TERMS

AMS	Altered mental status
ATS	Australasian triage scale
CS	Caesarean section
CTAS	Canadian triage and acuity scale
CXR	Chest x-ray
DAMA	Discharge against medical advice
ED	Emergency Department
EMD	Emergency Medicine Department
ESI	Emergency severity index
ETAT	Emergency triage, assessment and treatment
HIC	High-income countries
HIV	Human immunodeficiency virus
ITS	Ipswich triage scale
LIC	Low-income countries
LTS	Local triage scale
MIC	Middle-income countries
MNH	Muhimbili National Hospital
MRDT	Rapid diagnostic test for malaria
MTS	Manchester triage scale
MUHAS	Muhimbili University of Health and Allied Science
NTMC	Non-traumatic medical complaints
PedCTAS	Paediatric Canadian triage and acuity scale
RBG	Random blood glucose
SATS	South African triage scale
SVD	Spontaneous vertex delivery
TEWS	Triage early warning score
TS	Triage sale(s)
WHO	World health organisation

DEFINITION OF KEY TERMS

Triage: Is the process of sorting and filtering patients based on medical priority (1)

In emergency department, “triage” refers to the methods used to assess patients’ severity of injury or illness within a short time after their arrival, assign priorities, and transfer each patient to the appropriate place for treatment (2).

1.0 INTRODUCTION

1.1 Background

Triage is the process of determining the priority of a patient to medical care based on the urgency and severity of their condition so as to optimize outcome (3,4). This process involves categorizing patients by urgency levels based on their medical complaints, vital signs, symptoms and available resources (4). The process of triage has several key advantages including quick identification of patients who need immediate attention and hence improving patient outcomes by avoiding delay (5). Furthermore, the process also helps in organizing, monitoring, evaluating and determining the department resources that patient might need based on urgency level (6,7).

The concept of triage was first introduced in the context of mass casualty incidents during the Napoleonic war (8). Triage systems were then adapted to use in civilian Emergency Medicine Departments (EMDs) by 19 60s as first recorded use of systematic triage in an EMD in USA (6,8). In 1970s the Ipswich Triage Scale (ITS) in Australia was introduced, which later was validated and adopted as the National Triage Scale (NTS) in 1993 and then validated as Australasian Triage Scale (ATS) (8). Development of ATS paved the way to the development of Canadian triage and acuity scale (CTAS) and Manchester Triage Scale (MTS) (8,9).

Development of EMDs has come at a time when both demand and overcrowding have risen. These facts couple with inappropriate presentation at EMD with complaints not warranting emergency care and the inherent unpredictability of most warranted presentations results in prolonged waiting time for patients. Emergency Medicine Department triage is thus essential in order to optimize patients' waiting times and resource allocation (4).

Worldwide, several systems have been developed to make the process of triaging at EDs more uniform. In all of these systems, patients are assigned the acuity level with the lowest

number being the most urgent (9,10). In some cases, the triage system is a single algorithm, while in others there are multiple algorithms based on the age and chief complaint. Such systems include Emergency Severity Index (ESI) that was developed in 1999 and widely used in United States (US). This triage system differs from other triage scales in that, it determines the patient's urgency based on the condition as well as predict the number of resources patient might use depending on the urgency level (7,11).

In United Kingdom (UK), Manchester triage scale is currently in use (9,12). It originated from Manchester triage group and it differs from other triage scales in that it uses a flow charts in making decision with regard to presenting complaint(9). In Australia, the ATS is the widely used triage scale at EDs of Australia and New Zealand(9). It is a five level, highest acuity being denoted by low number (13). In Canada, the Canadian association of emergency physicians developed the Canadian Triage and Acuity Scale (CTAS), which is 5-level triage scale. It was originated, but slightly differed from the ATS. This triage scale is widely implemented in Canada, and the urgency level of the patient is determined by both the severity of injury and the physical findings of the patient (9).

In Africa, the Cape Triage Group of Cape town developed the first triage system which was known as Cape Triage Score (CTS), and was validated in 2006 and adopted throughout South Africa as the South African Triage Scale (SATS) and is widely used throughout South Africa (8,10). Unlike ATS, MTS and CTAS, this system has four levels(9,10). It uses triage early warning scores (TEWS) to predict the acuity level(14).

Triaging in paediatrics has been challenging due to some factors such as the need for special communications skills and different response to physiological stressors such as dehydration and infections (11). To overcome this, several triage systems have been adapted, developed or modified to improve triaging in children (15). Unlike MTS, ATS and ESI which have been modified to accommodate paediatric population(16–19), CTAS and SATS have developed

specific tools for paediatric use (20,21).

In Low-income countries (LIC), WHO developed a tool known as Emergency Triage, Assessment and Treatment (ETAT) and is widely used in these countries (22). This triaging system is based on presenting complaints, signs and symptoms. Patients are triaged as emergency if they have emergency signs such as airway obstruction, convulsion and loss of consciousness. These patients are expected to be seen immediately (4,22). Any child presenting with at least one of the following symptoms / signs is triaged in urgent level (4,22). In this category, patients have to be seen without further delay. Such symptoms are: high temperature, very tiny baby (<2 months), trauma, severe pallor, severe pain, poisoning, respiratory distress, restless child (irritable, lethargic), malnourished child, oedematous child, patient sustained burn injury and child with urgent referral. All children presenting with neither emergent nor urgent signs are triaged as queue and they can wait.

In Tanzania, acute intake areas have no formalized triage system that is in place, whereby most health care facilities use ETAT tool for in-patient services (6). However in acute intake areas, triage is still challenging (23).

To date there are few fully developed emergency departments, Emergency medicine department of Muhimbili national hospital (EMD-MNH) being one of them. In this department, the triage system used has been adopted from ESI and modified to suit our population, whereby patients are categorized as emergency, priority or queue based on their presenting complaint, symptoms and signs (22). However, despite being in use for more than five years, little is known on the performance of the local triage system in comparison with Australasian, Manchester, Canadian and South African triage scale in predicting outcomes below the age of 5 years with non-traumatic medical complaints presenting to the MNH ED.

1.2 LITERATURE REVIEW

In a study done in 2006, by Robertson Steel et al on Evolution of triage systems, it has been explained clearly that triage systems at ED have been adopted from mass casualty where by the concept of triaging was introduced during mass casualty and in war (8).

Following its adoption, several systems have been validated for use in EDs. For instance, ESI has been shown to correctly predict patients' admission status. This has been shown in a study done in 2001 by Paula Tanabe et al on Reliability and validity of scores on the ESI, whereby high acuity level is associated with the increased likelihood of admission (24).

To date, there are four widely used systems namely ATS, CTAS, ESI and MTS. These systems have been validated in HIC. This has been shown in a study done in 2010 by Michael Christ et al on Modern triage in the emergency departments. In this study the author have identified the existing systems and their validity (2).

These systems differ from one another, for instance, ESI differs from other systems in that apart from predicting acuity level, it has the ability to predict number of resources that might be used by patients with regard to acuity level as it has been shown by Tanabe et al in the study done on the Emergency Severity Index(V3) (25).

In another study done by JU Young Lee et al on Validity of Canadian Triage and Acuity Scale in predicting resource utilization, it has been shown that mortality, need of admission and resource utilization increases significantly with increase in triage score, with sensitivity and specificity of 97.9% and 89.2% respectively (26).

MTS differ from other systems in that, it is an algorithm–based approach, based on presenting complaints as it has been explained in emergency triage education kit (27,28).

There has been some challenges associated with triage in paediatrics due to some factors such as wide range of vital signs and physiological stressors (11). To overcome these

challenges, several triage tools have been validated for use in this population. In a prospective observational study done by Van Veen et al in 2008 on Manchester triage system in paediatric emergency care, it has been found that MTS has moderate validity in paediatric emergency, with much more over-triage than under-triage. The sensitivity and specificity was 63%, 79%, respectively. This implied that 37% of paediatric patients were under-triaged while 21% were over-triaged(17).

ESI use in paediatric population has been found to be reliable as shown in a study done in Tabriz Iran by Jafari- Rouhi et al on The Emergency Severity Index, version 4, for paediatric triage: a reliability study in Tabriz children hospital. From the study, the likelihood of admission was found to increase with decrease in ESI level ($p < 0.0001$) with significant correlation between triage level and admission status in both paediatric triage nurse and paediatric Emergency physician, (spearman coefficient 0.304, 0.407 respectively) (11).

In another study done by Jocelyn Gravel et al on Validity of the Canadian Paediatric Triage and Acuity Scale in a tertiary care hospital, it has been shown that pedCTAS is a reliable tool in paediatric triage in EDs, whereby the triage level was found to have strong association with hospital admission, length of ED stay and admission to paediatric intensive care unit ($p< 0.001$) (29).

To date, there is no single triage system which is considered as gold standard, as was shown in a study done by FitzGerald et al on Emergency department triage revisited. In this study, the authors reviewed the major triage systems and the challenges of each and finally they have identified the need for having benchmarking in triage system by having a triage system which will stand as gold standard. Hence the need for further studies that will “compare the expression of CTAS, MTS and ATS in terms of the patterns of population descriptions, the outcomes and the consistency”(6).

2.0 CONCEPTUAL FRAMEWORK

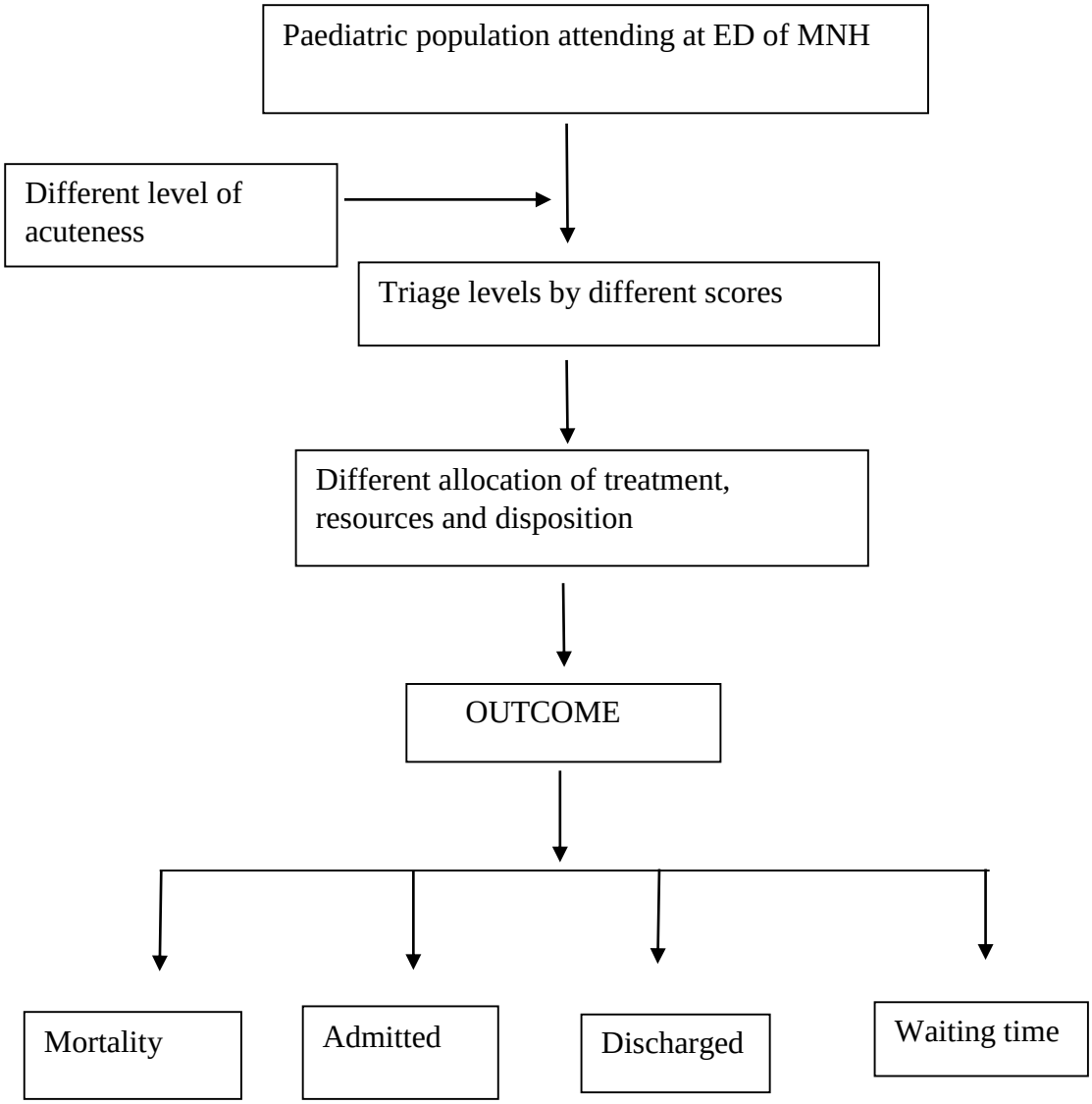


Fig. This conceptual framework is author's own formulation, explaining the flow of this study and its outcome.

3.0 PROBLEM STATEMENT

Triage system (TS) is required in emergency department (ED) in order to improve medical care and hence improve patient's outcome in terms of morbidity and mortality. It also helps in prioritising care, and minimise patients waiting time and hence avoid congestion and overcrowding. Proper triage system will allocate patients in categories hence time required before the physician sees patients according to the level of acuteness and hence helps reduce mortality and morbidity.

Lack of triage systems in acute intake areas remained to be the biggest challenge in LIC. To date the most triage tool used in in patients is ETAT which has been validated in few selected countries such as Malawi and Kenya and others have been validated for use in High-Income Countries (HIC) such as Canadian Triage and Acuity Scale (CTAS), Manchester Triage Scale (MTS), Australasian Triage Scale (ATS) and Emergency Severity Index (ESI) and in Middle-Income Countries (MIC) such as South African Triage Scale (SATS).

In Tanzania, Emergency medicine is the new field that continues to grow. To date, there are few working EDs and one of them is the EMD found at MNH. The triage tool used in this department is modified ESI. However little is known on the performance of the local triage system in comparison with Australasian, Manchester, Canadian and South African triage scale in predicting outcomes below the age of 5 years with non-traumatic medical complaints presenting to the MNH ED.

4.0 RATIONALE

In this study, we compared the performance of our LTS with other validated triage scales (ATS, CTAS, SATS, and MTS). The results of this study will highlight its performance in relation to others and hence will help us in documenting its ability to predict the urgency of patient's medical care and need for admission. The study will also inform the performance of international triage scales when applied to local LIC where disease patterns are not similar to HIC in which most of these scales have been validated.

5.0 RESEARCH QUESTION

What is the performance of local, Australasian, Manchester, Canadian and South African triage scale in predicting outcomes below the age of 5 years with non-traumatic medical complaints presenting to the MNH ED?

6.0 OBJECTIVES

6.1 Broad objective:

To compare the performance of local, Australasian, Manchester, Canadian and South African triage scale in predicting outcomes below the age of 5 years with non-traumatic medical complaints presenting to the MNH ED.

6.2. Specific objectives:

1. To determine the proportions of triage levels by each scale of paediatric patients below the age of five years presenting with non- traumatic medical complaints to the EMD-MNH.
2. To describe the relationship between Local, Australasian, Manchester, Canadian and South African triage scale in predicting need of hospital admission.
3. To compare Local, Australasian, Manchester, Canadian and South African triage scales in predicting 24hrs hospital mortality.
4. To describe the relationship between Local triage scale with waiting time.

7.0 METHODOLOGY

7.1 Study design:

This was prospective descriptive study of a consecutive convenience sampling of Paediatric patients below the age of five years with non-traumatic medical complaints presenting to the EMD-MNH between November 2017 and April 2018. Purposively designed data collection form was used to record patient's demographics, local triage level, clinical characteristics, final EMD disposition and a 24-hour follow-up outcome. Then same information was used to determine CTAS, ATS, MTS and SATS triage levels.

7.2. Study setting:

This study was conducted at Emergency Medicine Department in Muhimbili National Hospital. It is located in Ilala district, Dar es Salaam – Tanzania. Data was collected from November 2017 to April 2018. MNH is the only tertiary hospital, which receives patients referred from the whole country with the only public EMD in Tanzania. About 25% of patients seen in this department are paediatrics population with 75% presenting with non-traumatic medical conditions (30).

7.3. Study population:

All paediatric patients below the age of five years presented to EMD - MNH.

7.4. Study sample:

All paediatric patients below the age of five years presented at EMD-MNH with non-traumatic medical conditions and met inclusion criteria.

7.5. Subjects:

7.5.1 Inclusion criteria:

Paediatric patients below the age of five years presented to the EMD-MNH with non-traumatic medical conditions and whose parents/ guardian has consented to participate in the study.

7.5.2 Exclusion criteria:

- Paediatric patients below age of five years presented in state of cardiac or respiratory arrest.
- Patients who presented as follow up (medication refill and investigation results).

7.6. Variables.

7.6.1. Outcome Variables.

- Need for hospital admission.
- Mortality (24hrs).
- Time to be seen by ED doctors.

7.6.2. Predictor variables:

- Triage category (urgency level)

7.7. Study sampling.

This was a convenience consecutive sampling of all paediatric patients below the age of five years with NTMC presented consecutively to the EMD – MNH during the study period.

7.8. Sample size.

The sample size of this study was calculated based on the proportions of paediatric patients who previously were admitted in the same department. From the data (Wellsoft) search, the prevalence of paediatric patient needed admission was 59%.

Hence, sample size (N)

$N = \frac{Z^2}{E^2} \times P(1-P)$, where: Z =1.96

$N = \frac{1.96^2}{0.05^2} \times 0.59(1-0.59)$

N=372.

Thus; estimated minimum sample size required in this study was 372 Paediatric patients below the age of 5 years.

7.9. Data collection.

Patient recruitment and data collection was done by principle investigator and research assistance. Data sheet completion aimed recording vital signs, local triage level, the presenting complaint, weight and other important information as per data sheet.

After recording the initial information from each enrolled patient, the same information used to triage respective patient using local and other triage scales/tools, namely Manchester, Canadian, South African and Australasian triage scales and the acuity levels were recorded separately. This was used in determining the performance of different triage systems in predicting need for admission, waiting time and mortality in paediatric patients with NTMC.

Follow up of patients after they left EMD was done through phone calls and direct tracing to the ward for those who did not have contact (i.e. no phone number) or their phones were not reachable. Data was recorded in the data sheet, whether still in the ward, died within 24hrs or discharged.

7.10. Standardized data collection

A consecutive sampling method was used to enrol patients who met inclusion criteria and principle investigator or research assistant were available in the department (convenience). They recorded/retrieved preliminary data (demographics, vital signs and chief complaints), which was measured, recorded and documented in the patient's files and local triage charts by triage nurse. Then principle researcher used this information to determine the triage levels using the triage flow charts of the ATS, MTS, CTAS and SATS (Appendix/attached)

7.11. Data Management and analysis

From hand written data sheets, all data were held by the by principal investigator in a password protected and encrypted computer excel database. Data was transferred to SPPS software, cleaned and checked for outliers and analysed. For skewed data, Median and Interquartile range was calculated. Proportion of triage categories by triage scales was obtained in order to determine the distribution by acuity and their waiting time as per LTS. The recommended time to be seen by doctor according to triage levels (table below) was compared with actual findings of the study. For level 1 through 5 the recommended time is as in the following table.

Table: Recommended waiting time in different triage levels.

Triage Scale	**Recommended waiting time (minutes)**				
	Level 1	Level 2	Level 3	Level 4	Level 5
LTS	Immediate	Not specified	Not specified	N/A	N/A
MTS	Immediate	10	60	120	240
CTAS	Immediate	10	30	60	120
ATS	Immediate	10	30	60	120
SATS	Immediate	<10	<60	<240	N/A

Triage categories were then grouped into high acuity and low acuity, where high acuity comprised of level one and two, and low acuity was comprised of level 3 to 5 of MTS, CTAS, and ATS For LTS, high acuity was comprised of level 1 only and low acuity comprised of level 2 and 3 and for SATS high acute included level one and two, low acuity was made up by level 3 and 4. Sensitivity and specificity was then calculated based on the high and low acuity groups so as to determine the ability of the triage scales in predicting need for admission and 24hrs mortality. Due to lack of gold standard, admission and mortality were used as gold standard in calculating sensitivity and specificity. In the final analysis (24hours outcome), 41 (4.9%) patients were excluded due to missing data.

7.12 Ethical consideration:

All paediatric patients below the age of five years who met inclusion criteria had equal opportunity to participate in the study, and the parent/caretaker was asked to provide a written consent. Before enrolment, the principal investigator / research assistant explained the purpose of study to the parent/care taker. Patients whose parent/ caretaker refused to sign consent form was excluded from the study.

The study was purely observational hence did not change any patients treatment plan,

whether enrolled or not. No offer was given to study participants and confidentiality of all collected information was highly observed and maintained.

8.0 RESULTS.

8.1 Demographic characteristics.

We enrolled 384 patients, the median age was17months (Interquartile range 7-36 months) and 211 (54.9%) were male, 67 (17.4%) were triaged in emergency, 291 (75.8%) in priority group and 26 (6.8%) in queue group by LTS. Those reported to have comorbidities were 78, of which SCD, CHD and HIV accounted for 8.4%, 10.9% and 1.7% respectively. Overall, 178 (46.4%) of patients were referred from other hospitals. (Table 1)

Table 1: Demographics characteristics of children presented to ED with NTMC

	Characteristics	Frequency (%)
	Median age in months (IQR)	17 (7-36)
	Sex – male	211 (54.9%)
	Referral status	
-	Referred	178 (46.4%)
-	Not referred	206 (53.6%)
	Co-morbidities	
-	Sickle cell disease	10 (08.4%)
-	Congenital heart diseased	13 (10.9%)
-	HIV	02 (01.7%)
-	*Unknown	94 (79%)
	Local triage scale	
-	Emergency (level 1)	68 (17.4%)
-	Priority (level 2)	291 (75.8%)
-	Queue (level 3)	26 (6.8%)

Key: HIV-Human Immunodeficiency Syndrome

* Unknown – they were not reported whether they have comorbidities or not.

8.2. Proportion of triage levels by each triage scale.

Among 384 children, LTS categorized majority of the patient in level 2 (75.8%) and SATS had majority 245 (63.8%) in least urgent category i.e. Level 4. According to MTS, ATS and CTAS showed a trend of increasing number of patients from as the level of urgency decreases, i.e. few patients were categorized in level one and majorities were in level 5. (Table 2a)

Table 2a: Proportion of patients in triage category by each triage scale

Triage scale	Triage levels* (%)				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
LTS**	67 (17.4)	291 (75.8)	26 (6.8)	N/A	N/A
MTS	35(9.1)	36 (9.4)	43 (11.2)	140 (36.5)	130 (33.9)
ATS	24(6.3)	47 (12.2)	47 (12.2)	86 (22.4)	179 (46.6)
CTAS	28(7.3)	42 (10.9)	70 (18.2)	74 (19.3)	170 (44.3)
SATS	45 (11.7)	29 (7.6)	65 (16.9)	245 (63.8)	N/A

* The urgency decreases as the number increases. Level 1 is the sickest patient while level 5 is less urgent and the recommended time to be seen by doctor according to these triage levels depends on the urgency category. For level 1 through 5 the recommended time is as follows; MTS immediate/ 10/60/120/240 minutes, CTAS and ATS: immediate/10/30/60/120 minutes, SATS immediate, <10 minutes, <1hr, and <4hrs for level-1,2,3 and 4 respectively.
****** The recommended time to be seen by doctor is immediate in level 1, level 2 and 3 not specified.

Among 67 patients who were triaged as emergency (Level 1) by LTS, only 37.3%, 32.8%, 28.4% and 53.7% were identified as same level (level 1) according to MTS, CTAS, ATS and SATS respectively. Comparing least urgent patients, 26 patients who were categorised by LTS as level 3, among them MTS identify 57.7%, CTAS (53.8%), ATS (65.4%) and SATS (80.8%) as the least urgent patients. (Table 2b)

Table 2b: Categorization of patients into triage scales by LTS

Triage system	Triage levels	Local triage score (N = 384)		
		Emergency N= 67	Priority N=291	Queue N = 26
MTS	1	25 (37.3%)	11 (3.8%)	-
	2	23 (34.3%)	12 (4.1%)	1 (3.8%)
	3	11 (16.4%)	30 (10.3%)	2 (7.7%)
	4	6 (9.0%)	126 (43.3%)	8 (30.8%)
	5	2 (3.0%)	112 (38.5%)	15 (57.7%)
CTAS	1	22 (32.8%)	6 (2.1%)	-
	2	24 (35.8%)	15 (5.2%)	3 (11.5%)
	3	12 (17.9%)	55 (18.9%)	3 (11.5%)
	4	6 (9.0%)	62 (21.3%)	6 (23.1%)
	5	3 (4.5%)	153 (52.6%)	14 (53.8%)
ATS	1	19 (28.4%)	5 (1.7%)	-
	2	28 (41.8%)	18 (6.2%)	2 (7.7%)
	3	10 (14.9%)	34 (11.7%)	3 (11.5%)
	4	8 (11.9%)	74 (25.4%)	4 (15.4%)
	5	2 (3.0%)	160(55.0%)	17 (65.4%)
SATS	1	36 (53.7%)	8 (2.7%)	1 (3.8%)
	2	11 (16.4%)	16 (5.5%)	2 (7.7%)
	3	10 (14.9)	53 (18.2%)	2 (7.7%)
	4	10 (14.9%)	214(73.5%)	21 (80.8%)

8.3. Relationship between the triage scales in predicting need for hospital admission.

Among 384 patients, 229 (59.6%) were admitted, 39.85% discharged and 0.5% died at ED. In all triage scales majority of level-one patients were admitted and the number of patients discharged increased with decreasing level of urgency except for LTS where 89.5% of discharged patients were in level 2. In the least urgent levels, more patients were discharged compared to admission. (Table 3a)

Table 3a: Relationship of triage scales with admission, mortality and discharge

Triage system	Triage levels	Emergency Department Disposition		
		Admitted (N = 229)	Discharged (N = 153)	Died at ED (N = 2)
LTS	1	62 (7.1%)	3 (2%)	2 ((100%)
	2	154(67.2%)	137(89.5%)	-
	3	13 (5.7%)	13 (8.5%)	-
MTS	1	33(14.4%)	1 (0.7%)	2 (100%)
	2	32 (14%)	4 (2.6%)	-
	3	35(15.3%)	8 (5.2%)	-
	4	79(34.5%)	61 (39.9%)	-
	5	50(21.8%)	79 (51.6%)	
ATS	1	22 (9.6%)	1 (0.7%)	1(50%)
	2	43 (18.8%)	4 2.6%)	1(50%)
	3	36 (15.7%)	11 (7.2%)	-
	4	52 (22.7%)	34 (22.2%)	-
	5	76 (33.2%)	103(67.3%)	-
CTAS	1	26 (11.4%)	1 (0.7%)	1 (50%)
	2	37 (16.2%)	4 (2.6%)	1(50%)
	3	54 (23.6%)	16 (10.5%)	-
	4	35 (15.3%)	39 (25.5%)	-
	5	77 (33.6%)	93 (60.8%)	-
SATS	1	43 (18.8%)	1 (0.7%)	1 (50%)
	2	22 (9.6%)	6 (3.9%)	1 (50%)
	3	48 (21%)	17 (11.1%)	-
	4	116 (50.7%)	129(84.3%)	-

In order to calculate sensitivity and specificity, patients were then categorised into two groups of acuity namely high and low acuity. In all triage levels, patients who died at ED were in high acuity group; more admitted patients were in high acuity and majority of discharge were from low acuity groups. (Table 3b)

Table 3b: Relationship between admission and the acuity level of each triage scale

Triage scales	Triage acuity category	Outcome at ED		
		Admitted (N=229)	Discharged (N=153)	Died (N=5)
LTS	High	62 (27.1%)	3 (2.0%)	2 (100%)
	Low	167 (72.9%)	150 (98%)	-
MTS	High acuity	65 (28.4%)	5 (3.3%)	2 (100%)
	Low acuity	164 (71.6%)	148 (96.7%)	-
CTAS	High acuity	63 (27.5%)	5 (3.3%)	2 (100%)
	Low acuity	166 (72.5%)	148 (96.7%)	-
ATS	High acuity	65 (28.4%)	5 (3.3%)	2 (100%)
	Low acuity	164 (71.6%)	148 (96.7%)	-
SATS	High acuity	65 (28.4%)	7 (4.6%)	2 (100%)
	Low acuity	164 (71.6%)	148 (95.4%)	-

Key: High acuity: Level 1& 2 for MTS, CTAS, ATS, and Emergency for LTS
Low acuity: Level 3, 4, & 5 for MTS, CTAS and ATS, Level 3&4 for SATS and Queue for LTS

Table 3c: Prediction of need for admission by triage scales

Triage scales	Sensitivity	Specificity	PPV	NPV
LTS	27.1%	98.0%	95.4%	47.3%
MTS	8.4%	96.7%	92.9%	47.4%
ATS	28.4%	96.7%	92.9%	47.4%
CTAS	27.5%	96.7%	92.6%	47.1%
SATS	28.4%	95.4%	90.3%	47.1%

8.4. Comparison of triage scales in predicting 24hrs mortality.

Among those patients who died, we found 6.0% and 16.7% were identified level one according to local triage and Australian scale respectively. None of the patients died among the least urgent patients. The urgency was better predicted my Manchester triage scale as all died patents were in level one only. (Table 4a)

With regard to ability to predict 24hours mortality in high acuity, patients were categorised into high acuity and low acuity. 41 patients were excluded due to missing data on 24 hrs outcome. Sensitivity and specificity were then calculated. LTS has least ability to predict mortality (Sensitivity 80% and specificity 81.4%) compared to MTS, ATS, CTAS and SATS (sensitivity of 100% in all). (Table 4b)

Table 4a: Relationship between triage levels of each triage scale with 24hrs outcome

Triage system	Triage levels	Outcome at 24 hours	
		Survived N=339	Died N = 5
LTS	1	63 (94%)	4 (6.0%)
	2	253 (99.6%)	1 (0.4%)
	3	23 (100%)	-
MTS	1	31(86.1%)	5(13.9%)
	2	36(100%)	-
	3	42 (100%)	-
	4	117(100%)	-
	5	113(100%)	-
ATS	1	20(83.3%)	4(16.7%)
	2	47(97.9%)	1(2.1%)
	3	46(100%)	-
	4	79(100%)	-
	5	147(100%)	-
CTS	1	24(85.7%)	4(14.3%)
	2	41(97.6%)	1(2.4%)
	3	67(100%)	-
	4	61(100%)	-
	5	146(100%)	-
SATS	1	41(91.1%)	4(8.9%)
	2	27(96.4%)	1(3.6%)
	3	62(100%)	-
	4	209(100%)	-

Table 4b: Proportion of paediatrics patients died after 24 hours by triage scale

		24 hours outcome	
Triage scales	Triage acuity category	Died (N = 5)	Survived (N = 339)
LTS	High	4 (80%)	63 (18.6%)
	Low	1 (20%)	276 (81.4%)
MTS	High	5 (100%)	67 (19.8%)
	Low	-	272 (80.2%)
ATS	High	5 (100%)	67 (19.8%)
	Low	-	272 (80.2%)
CTAS	High	5 (100%)	65 (19.2%)
	Low	-	274 (80.8%)
SATS	High	5 (%)	68 (20.1%)
	Low	-	271 (79.9%)

Table 4c: Prediction of 24hrs Mortality by Triage Scales

Triage scale	**Sensitivity**	**Specificity**	**PPV**	**NPV**
LTS	80%	81.4%	6.0%	99.6%
MTS	100%	80.2%	6.9%	100%
ATS	100%	80.2%	6.9%	100%
CTAS	100%	80.8%	7.1%	100%
SATS	100%	79.9%	6.8%	100%

8.5 The relationship between triage scales with waiting time.

In this study, majority of patients (42.7%) were seen within 11 – 60, and only 16.4% were seen in less than 11 minutes. (Table 5a).

Table 5a: Distribution of patients according to waiting time

Waiting time (Minutes)	Frequency (%)
Less than 11	63 (16.4%)
11 - 60	164 (42.7%)
More than 60	157 (40.9%)
TOTAL	384 (100%)

The distribution of the patients according to triage levels was found to be varying between triage scales. In LTS most of level 1 patients were seen in 11 – 60 minutes (22.0%), while 15.9% patients were seen in more than 60minutes. In least acuity, LTS had 9 (14.3%) who were seen in less than 11 minutes. In MTS 13 (8.3%) of patients were seen in more than 60 minutes while 21 (31.7%) were seen in <11minutes. SATS identified 44 (69.8%) of level 4 patients to be seen in < 11 minutes while only 2 (3.2%) of level patients were seen within the same time. ATS, CTAS and SATS had >5% of level 1patients seen >60minutes. . Overall, majority of patients categorised in level 5 while in MTS 35% of level 5 patients were seen in > 60minutes., ATS and CTAS were seen in > 60minutes, while the trend has been found to decrease with SATS (46.9%) and LTS (46.2%). (Table 5b).

Table 5b: Relationship of waiting time with triage categories

		Waiting time		
Triage scale	Triage category	<11minutes (N = 63)	11-60min(N=164)	>60minutes (N = 157)
LTS	Level 1	6 (9.5%)	36 (22.0%)	25 (15.9%)
	Level 2	48 (76.2%)	123 (75.0%)	120(76.4%)
	Level 3	9 (14.3%)	5 (3.0%)	12 (7.6%)
MTS	Level 1	4 (6.3%)	19 (11.6%)	13 (8.3%)
	Level 2	6 (9.5%)	19 (11.6%)	11 (7.0%)
	Level 3	12 (19.0%)	22 (13.4%)	9 (5.7%)
	Level 4	21 (33.3%)	64 (39.0%)	55 (35.0%)
	Level 5	20 (31.7%)	40 (24.4%)	69 (43.9%)
ATS	Level 1	1 (1.6%)	10 (6.1%)	13 (6.3%)
	Level 2	10 (15.9%)	26 (15.9%)	12 (7.6%)
	Level 3	13 (20.6%)	31 (18.9%)	3 (1.9%)
	Level 4	18 (28.6%)	48 (29.3%)	20 (12.7%)
	Level 5	21 (33.3%)	49 (29.9%)	109(69.4%)
CTAS	Level 1	3 (4.8%)	13 (7.9%)	12 (7.6%)
	Level 2	8 (12.7%)	25 (15.2%)	9 (5.7%)
	Level 3	11 (17.5%)	42 (25.6%)	17 (10.8%)
	Level 4	12 (19.0%)	30 (18.3%)	74 (19.3%)
	Level 5	29 (46.0%)	54 (32.9%)	87 (55.4%)
SATS	Level 1	2 (3.2%)	25 (15.2%)	18 (11.5%)
	Level 2	6 (9.5%)	15 (9.1%)	8 (5.1%)
	Level 3	11 (17.5%)	38 (23.2%)	16 (10.2%)
	Level 4	44 (69.8%)	86 (52.4%)	115(73.2%)

9.0 DISCUSSION

To the best of our knowledge, this is the first study done in LMIC that highlight the relationship of different triage scales at ED in predicting outcome of patients with NTMC. Several studies have been done to evaluate the performance of triage scales at ED in predicting the need for admission and mortality(15,16,19,30), but most of these studies have been done and validated in HIC (2).

The use of Triage systems at ED helps to prioritize patients' care according to the severity of their illness by assigning acuity level. In this study, patients were triaged by using all five triage scales and were assigned appropriate triage levels accordingly. LTS triaged more patients 67(17.4%) in level 1 compared to MTS, CTAS, ATS and SATS. However this difference is due to the differences in number of acuity levels whereby LTS has 3 levels unlike MTS, CTAS and ATS, which have 5 levels, and SATS that has 4 levels.

CTAS is among the four widely used triage scales in paediatric patients. Among all patients who were identified as emergency (the highest acuity) by LTS, CTAS identified 22 (78.6%) of them as resuscitation. The lower percentage in CTAS observed in this study can be explained by the fact that CTAS use five categories hence more distribution within the groups while LTS use three category (2).

Ideal triage tool should be able to correctly identify many patients for admission in highly acute group and many for discharge in least acute categories. In this study it has been found that the percentage of hospital discharge decreases with the level of urgency. For example, in SATS, the percentage of discharge increased from 0.7% in level one to 84.3% in level four categories. Similar trends have been found in a study done during validation of the revised pediatric SATS in which it was increased from 27.2% among emergency category to 95.3% in non-urgent patients (21). The similarity is due to nature of all triage tools in ED that has designed to identify sickest patient to be seen earlier and be admitted while less sick patients being discharged.

In absence of the gold standard among the triage tools in this study, admission and mortality were used as reference standard, against which specificity and sensitivity was calculated. In predicting mortality, LTS showed least ability to predict mortality compared to MTS, ATS, CTAS and SATS (sensitivity of 100%, NPV 100%). The high specificity in our study can be due to the different types of patients seen in ED as case mix. The ED system doesn't take only emergency patients but also accept non-emergency patients who come as insured / private patients and also those who come for elective admissions. These are mostly stable patients, which can easily be identified, treated and discharged.

In predicting need for admission, all triage scales were found to have low sensitivity (<50%) and high specificity. These findings differ from those found in a study done by *Aeimchanbanjong et al,"validation of different pediatric triage systems in the emergency department"* where MTS and CTAS were found to have higher sensitivity and specificity (31) compared to our findings. ATS had lower sensitivity (13%) (31), which relatively correlates with the findings in our study. The differences in low sensitivity observed among all triage scales used in this study means the scales picked many false negative regarding admissions, this is due to hospital admission policy that sometimes patients are admitted for other reason rather than acuteness of illness. E.g. all patients referred from other regions other than Dar es salaam has to be admitted for social reason that they might have no place to stay. All trauma patients have to be transferred to Muhimbili orthopedics Institutes (MOI) through MNH admission system i.e. must be admitted at MNH then transferred to MOI.

Triage system is important tool at ED that helps minimize the waiting time to treatment through prioritizing seriously sick patients (31). In this study, LTS and SATS found that more than 10% of level 1 patients had a waiting time of more than 60 minutes while 14.3% of least urgent patients identified by LTS were seen in less than eleven minutes. This is in contrary to the recommend time in most of the validated triage scales, where level 1 patients have to be seen immediate, while allowing least urgent patients to wait for two to four hours. This has been reported in several studies, one of them being a study done by Christ et al, where it has been reported that the recommended waiting time for level 2 patients by MTS and ATS is 10 minutes (2). The more waiting time in emergency (level 1) group and short waiting time in least urgent category observed in this study can be explained by departmental working plan for doctors on duty to equally distribute themselves to high and lower acuity patients. This is inappropriate as ideally more resources should be allocated to sickest patients (level one and two).

LIMITATIONS.

i. Although this was a single centre based study, which could limit the generalization of the study results, however, EMD-MNH being receiving patients from the whole country hence the sample studied can be representative of the true populations.
ii. The sampling method was based on Convenience sampling hence may lead to missing of some patients who might have met inclusion criteria. The investigator and research assistant being available in alternate day and night, through regular checking of medical records and triage records on patients' information system

(Wellsoft) and visiting both treatment and resuscitation rooms this has maximized the capture of patients.

iii. Lack of gold standard during sensitivity and specificity calculations lead to use of actual count on admission and discharge which might be affected by other social reasons than medical indications e.g. DAMA.

10.0 CONCLUSION

There are performance variations among the triage scales (LTS, MTS, CTS, ATS and SATS) in predicting urgency to medical care (need for admission and waiting time) and mortality among Paediatric population. However, all triage tools studied showed similar trend in increase number of discharge from high to low acuity triage levels. It is important for further studies to be done to evaluate its reliability and validity and hence make its use to be Nationwide.

11.0 RECOMMENDATIONS

Following the results of this study, we recommend the following;

- The distribution of human resources at the Emergency Medicine Department of Muhimbili National Hospital should be directed in favors of severely acute patients so that these patients are seen within recommended time of the Local triage scale.
- Stable patients that do not need emergency care should be directed to appropriate areas other than Emergency department such as outpatient department so as to minimize congestion at EMD.
- The admission policy of Muhimbili National Hospital to be reviewed so that to minimize admission rates.
- Further studies need to be done to evaluate its reliability and validity in predicting the performance of these triage scales in predicting outcome of non-traumatic paediatric population.

12.0 REFERRENCES.

1. Twomey M, Wallis LA, Myers JE. Limitations in validating emergency department triage scales. Emerg Med J EMJ. 2007 Jul; 24(7):477–9.

2. Christ M, Grossmann F, Winter D, Bingisser R, Platz E. Modern Triage in the Emergency Department. Dtsch Ärztebl Int. 2010 Dec;107(50):892–8.

3. Triage. In: Wikipedia [Internet]. 2017 [cited 2017 Feb 19]. Available from: https://en.wikipedia.org/w/index.php?title=Triage&oldid=765872998

4. Sixtus_Ruyumbu_Safari.pdf [Internet]. [cited 2017 Feb 20]. Available from: http://ihi.eprints.org/1599/1/Sixtus_Ruyumbu_Safari.pdf

5. Farrohknia N, Castrén M, Ehrenberg A, Lind L, Oredsson S, Jonsson H, et al. Emergency Department Triage Scales and Their Components: A Systematic Review of the Scientific Evidence. Scand J Trauma Resusc Emerg Med. 2011;19:42.

6. Emergency-Department-Triage-Revisited.pdf [Internet]. [cited 2017 Feb 25]. Available from: https://www.researchgate.net/profile/George_Jelinek/publication/41435236_Emergency_Department_Triage_Revisited/links/0c96052417664880dd000000/Emergency-Department-Triage-Revisited.pdf

7. Emergency Severity Index. In: Wikipedia [Internet]. 2016 [cited 2017 Feb 19]. Available from: https://en.wikipedia.org/w/index.php?title=Emergency_Severity_Index&oldid=737066414

8. Robertson-Steel I. Evolution of triage systems. Emerg Med J EMJ. 2006 Feb;23(2):154–5.

9. TRIAGE_SCALE_IP.PDF - zotero://attachment/183/ [Internet]. [cited 2017 Apr 24]. Available from: zotero://attachment/183/

10. Gottschalk SB, Wood D, DeVries S, Wallis LA, Bruijns S. The cape triage score: a new triage system South Africa. Proposal from the cape triage group. Emerg Med J. 2006 Feb 1;23(2):149–53.

11. Jafari-Rouhi AH, Sardashti S, Taghizadieh A, Soleimanpour H, Barzegar M. The Emergency Severity Index, version 4, for pediatric triage: a reliability study in Tabriz Children's Hospital, Tabriz, Iran. Int J Emerg Med. 2013 Oct 2;6:36.

12. THE MANCHESTER TRIAGE SYSTEM - 2-J. Windle.pdf [Internet]. [cited 2017 Feb 19]. Available from: http://www.triage.it/congresso/images/edocs/abstract/1sess/slide/2-J.%20Windle.pdf

13. Page 1 of 3 - Examples_of_triage_conditions.pdf [Internet]. [cited 2017 Feb 19]. Available from: http://www.bhi.nsw.gov.au/__data/assets/pdf_file/0016/170620/Examples_of_triage_conditions.pdf

14. Rominski S, Bell SA, Oduro G, Ampong P, Oteng R, Donkor P. The implementation of the South African Triage Score (SATS) in an urban teaching hospital, Ghana. Afr J Emerg Med. 2014 Jun 1;4(2):71–5.

15. van Veen M, Moll HA. Reliability and validity of triage systems in paediatric emergency care. Scand J Trauma Resusc Emerg Med. 2009 Aug 27;17:38.

16. Seiger N, Veen M van, Almeida H, Steyerberg EW, Meurs AHJ van, Carneiro R, et al. Improving the Manchester Triage System for Pediatric Emergency Care: An International Multicenter Study. PLOS ONE. 2014 Jan 15;9(1):e83267.

17. Veen M van, Steyerberg EW, Ruige M, Meurs AHJ van, Roukema J, Lei J van der, et al. Manchester triage system in paediatric emergency care: prospective observational study. BMJ. 2008 Sep 22;337:a1501.

18. Validity of the Manchester Triage System in paediatric emergency care (PDF Download Available). ResearchGate [Internet]. [cited 2017 Feb 19]; Available from: https://www.researchgate.net/publication/6667143_Validity_of_the_Manchester_Triage_System_in_paediatric_emergency_care

19. Travers DA, Waller AE, Katznelson J, Agans R. Reliability and Validity of the Emergency Severity Index for Pediatric Triage. Acad Emerg Med. 2009 Sep 1;16(9):843–9.

20. Revisions to the Canadian Triage and Acuity Scale Paediatric Guidelines (PaedCTAS) (PDF Download Available) [Internet]. ResearchGate. [cited 2017 May 12]. Available from: https://www.researchgate.net/publication/23483353_Revisions_to_the_Canadian_Triage_and_Acuity_Scale_Paediatric_Guidelines_PaedCTAS

21. Twomey M, Cheema B, Buys H, Cohen K, de Sà A, Louw P, et al. Vital signs for children at triage: A multicentre validation of the revised South African Triage Scale (SATS) for children. SAMJ South Afr Med J. 2013 May;103(5):304–8.

22. WHO | Emergency Triage Assessment and Treatment (ETAT) course [Internet]. WHO. [cited 2017 Feb 20]. Available from: http://www.who.int/maternal_child_adolescent/documents/9241546875/en/

23. Assessment of knowledge and skills of triage amongst nurses working in the emergency centres in Dar es Salaam, Tanzania - pdf [Internet]. [cited 2017 Feb 28]. Available from: http://www.afjem.org/article/S2211-419X(13)00075-X/pdf

24. Tanabe P, Gimbel R, Yarnold PR, Kyriacou DN, Adams JG. Reliability and Validity of Scores on the Emergency Severity Index Version 3. Acad Emerg Med. 2004 Jan 1;11(1):59–65.

25. Tanabe P, Gimbel R, Yarnold PR, Adams JG. The Emergency Severity Index (version 3) 5-Level Triage System Scores Predict ED Resource Consumption. J Emerg Nurs. 2004 Feb 1;30(1):22–9.

26. Lee JY, Oh SH, Peck EH, Lee JM, Park KN, Kim SH, et al. The validity of the canadian triage and acuity scale in predicting resource utilization and the need for immediate life-saving interventions in elderly emergency department patients. Scand J Trauma Resusc Emerg Med. 2011;19:68.

27. Triage Education Kit.pdf [Internet]. [cited 2017 Feb 19]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/387970CE723E2BD8CA257BF0001DC49F/$File/Triage%20Education%20Kit.pdf

28. Validity of the Manchester Triage System in emergency care: A prospective observational study [Internet]. [cited 2017 May 15]. Available from: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0170811

29. valid-gravel-la - S1481803500010885 [Internet]. [cited 2017 May 15]. Available from: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/S1481803500010885

30. Baumann MR, Strout TD. Evaluation of the Emergency Severity Index (version 3) Triage Algorithm in Pediatric Patients. Acad Emerg Med. 2005 Mar 1;12(3):219–24.

31. WJEM-8-223.pdf [Internet]. [cited 2018 May 12]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5496831/pdf/WJEM-8-223.pdf

13.0APPENDICES

13.1. Appendix I: CONSENT FORM (English version).

ID NO…….

PERMISSION FOR YOU TO TAKE PART IN RESEARCH.

Study title: COMPARISON OF LOCAL, AUSTRALASIAN, CANADIAN, MANCHESTER AND SOUTH AFRICAN TRIAGE SCALES IN PREDICTING OUTCOMES OF PAEDIATRIC PATIENTS BELOW THE AGE OF FIVE YEARS WITH NON-TRAUMATIC MEDICAL COMPLAINTS PRESENTING AT EMEREGENCY MEDICINE DEPARTMENT OF MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM, TANZANIA.

Introduction: You are being asked to take part in this study because I am looking at the outcomes of paediatric patients below five years presenting at Emergency Medicine Department with non-traumatic medical complaints by comparing different triage systems as mention above when applied to this population and whether these scales can predict the outcomes.. Your decision whether or not to participate will have no effect on the quality of medical care you will be given. Please ask questions if there is anything about this study you do not understand.

What is the purpose of this study? The purpose of this study is to compare the performance of the above named triage scales in predicting outcomes of pediatric patients below the age of five years presenting with non-traumatic medical complaints to the Emergency Medicine Department of Muhimbili National Hospital.

Will you benefit from taking part in this study?

You will be a volunteer and might not personally benefit from being in this research study. However, results from this study are expected to be a baseline for knowing the performance of these triage scales in our population such that they can be used in acute intake areas to improve medical care services throughout the country.

What does this study involve?

Some information about you will be asked, together with information that have recorded in your treatment chart will be recorded in a special form for the purpose of this study. Your name will not be recorded. No treatment or any intervention will be done.

What are the options if you do not want to take part in this study?

Your participation in this study is completely voluntary. You will continue to receive regular care regardless of whether you participate in the study or not.

What are the risks involved with taking part in this study?

Since no intervention of any kind will be done we anticipate no risks to your health.

Leaving the study: You may choose to stop taking part in this study at any time for any reason. If you decide to stop taking part, it will have no effect on your medical care.

New Information: New information related to this study and specifically new information

will be made known to you when it becomes available.

How will your privacy be protected?

Information about you as well as the test results will be kept strictly confidential. The study information will be stored in protected computer files and in paper records stored in locked filing cabinets. Only study staff will have access to the information. The information will be maintained indefinitely.

Who may use or see your health information?

By signing this form, you allow the research team to use your health information and give it to others involved in the research. The research team includes the principle investigator, supervisor, research assistant and MUHAS staffs that will be involved in reviewing my research report.

Your permission to use your health information for this study will not end until the study is completed. You may ask for your study data at any time.

It is possible for a court or government official to order the release of study data including information about you.

What if you decide not to give permission to use and share your personal health information?

If you do not allow use of your health information for this study, you may not take part in this study. If you choose to stop taking part in this study, you may cancel permission for the use of your health information.

You should let the researcher know if you want to cancel your permission. The study team will assist you in putting your wishes in writing. Information collected for the study before your permission is cancelled will continue to be used in the research.

Whom should you call about this study?

If you have questions about this study or need to report a study related injury, you can call your doctor or the principle investigator for this study: Dr Nafsa R. Marombwa-0718984761, during normal working hours.

If you have questions about your rights as a participant, you may contact, Professor Mainen Moshi, Director of Publications and Research, Muhimbili University of Health and Allied Sciences, Research and Publication Committee, P. O. Box 65001, Dar es Salaam, Telephone number 2150302-06

What about the costs of this study?

There will be no costs for you if you agree to participate in the study. All study costs will be supported by the research team and MUHAS.

Will you be paid to take part in this study?

There will be no payment to you for participation in the study.

If you agree to take part in this study and you sign this consent form, you are not giving up any of your legal rights.

CONSENT: I have read the above information about COMPARISON OF LOCAL, AUSTARALASIAN, CANADIAN, MANCHESTER AND SOUTH AFRICAN TRIAGE SCALES IN PREDICTING OUTCOMES OF PEDIATRIC PATIENTS BELOW THE AGE OF FIVE YEARS WITH NON-TRAUMATIC MEDICAL COMPLAINTS PRESENTING TO EMERGENCY DEPARTMENT AT MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM TANZANIA and have been given time to ask questions. I agree to take part in this study and I have been given a copy of this signed consent form.

SIGNATURE

_____

Researcher or Designee Signature and Date Printed Name

_____

Patient or Legally Authorized Representative and Date Printed Name

13.2. APPENDIX II. CONSENT FORM (Swahili version)

FOMU YA RIDHAA YA KUSHIRIKI KATIKA UTAFITI

Namba ya Utambulisho ……

Study title: COMPARISON OF LOCAL, AUSTARALASIAN, CANADIAN, MANCHESTER AND SOUTH AFRICAN TRIAGE SCALES IN PREDICTING OUTCOMES OF PEDIATRIC PATIENTS BELOW THE AGE OF FIVE YEARS WITH NON-TRAUMATIC MEDICAL COMPLAINTS PRESENTING TO EMERGENCY DEPARTMENT AT MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM TANZANIA.

Utangulizi:

Unaombwa kushiriki katika utafiti huu kwa sababu ninafanya uchunguzi wa kulinganisha namna ya uchambuzi wa wagonjwa wenye umri chini ya miaka mitano wanaokuja katika idara ya magonjwa ya dharura katika hospitali ya taifa ya Muhimbili na malalamiko yasiyo ya majeraha na namna wanavyopewa kipaumbele katika matibabu kulingana na uharaka wao na matokeo yao baada ya matibabu hayo. Uamuzi wako wa kushiriki au kutoshiriki hautakua na athari zozote kwenye ubora wa huduma utakayopewa. Tafadhali uliza swali kama kuna kitu usichokielewa kuhusu utafiti huu.

Je dhumuni la utafiti huu ni lipi?

Dhumuni la utafiti huu ni kulinganisha matokeo ya njia tofauti za uchambuzi wa wagonjwa (njia tajwa kwenye kichwa cha habari) wenye umri chini ya miaka mitano wanaofika katika idara ya magonjwa ya dharura katika hospitali ya Taifa ya Muhimbili, na malalamiko yasiyo ya majeraha ,na namna njia hizo zinavyoweza kukadiria matokeo baada ya matibabu kulingana na uharaka wao.

Je utafaidika kwa kushiriki kwenye utafiti huu?

Inawezekana kuwa wewe binafsi usifaidike kwa kushiriki kwenye utafiti huu. Lakini matokeo ya utafiti huu yanategemewa kuwa msingi wa kuanzisha njia maalum ya uchambuzi wa wagonjwa katika vituo mbalia mbali nchi nzima na hivyo kuimarisha au/ kuboresha huduma za afya zitolewazo hasa kwa watoto kama hawa.

Je Utafiti huu unahusisha nini?

Taarifa zako zilizohifadhiwa kwenye faili lako la matibabu zitarekodiwa kwenye fomu maalum ya utafiti huu. Sambamba na hilo, utaulizwa baadhi ya maswali pale taarifa hizo zitakapooneka hazijakamilika. Taarifa za baadhi ya vipimo vyako zitarekodiwa pia.

Je itakuwaje kama hutataka kushiriki kwenye utafiti huu?

Kushiriki kwako kwenye utafiti huu ni hiari yako.. Utaendelea kupata huduma bila kujali kama umeshiriki kwenye utafiti ama la.

Je kuna athari gani za kushiriki katika utafiti huu?

Hakuna tiba itakayotolewa au vipimo vitakavyofanyika kwa lengo la utafiti huu. Kwa hiyo hakuna athari inayotegemewa kutokana na utafiti huu.

Kuondoka kwenye utafiti:

Unaweza kuamua kusitisha kuendelea kushiriki kwenye utafiti huu muda wowote na kwa sababu yoyote. Kama utaamua kuacha kushiriki hautaathiri huduma za afya kwako.

Maelezo mapya:

Utajulishwa maelezo mapya kuhusiana na utafiti huu mara tu yatakapokuwa yamepatikana. Utunzaji wa siri? Taarifa zako na majibu ya vipimo yatakayorekodiwa yatatunzwa kwa usiri mkubwa. Habari zihusuzo utafiti zitatunzwa kwenye kompyuta zenye ulinzi na rekodi, zilizopo kwenye makaratasi zitatunzwa kwenye makabati yanayofungwa. Ni wafanyakazi wanaohusika na utafiti tu ndio watakaoweza kuona taarifa, na taarifa hizi zitatunzwa siku zote.

Ni nani anaweza kutumia au kuona taarifa zako za afya?

Kwa kuweka sahihi kwenye fomu hii umeruhusu watafiti kutumia taarifa za afya yako na kuwapatia wengine wanaohusika na utafiti huu. Watafiti ni pamoja na mwendesha utafiti pamoja, msaidizi wa utafiti, msimamizi wa utafiti na wengine wanaohusika na utafiti huu ambao wapo chuo kikuu cha sayansi na tiba cha Muhimbili.

Ruhusa ya kutumia taarifa za afya yako itaisha wakati utafiti utakapokamilika. Unaweza kuomba taarifa za zako wakati wowote.

Inawezekana mahakama au afisa wa serikali akaamuru kuonyeshwa kwa taarifa za utafiti ikiwa ni pamoja na taarifa zako

Je itatokea nini kama utaamua kutotoa ruhusa ya kutumia na kushirikisha wengine taarifa zako za afya?

Kama hautaruhusu taarifa ya afya yako zitumike, hautaweza kushiriki kwenye utafiti huu. Kama utachagua kuacha kushiriki katika utafiti huu, unaweza kufuta ruhusa ya matumizi ya taarifa za afya yako. Watafiti watakusaidia kuweka matakwa yako kwenye maandishi. Taarifa zitakazokuwa zimekusanywa kabla ya kufuta ruhusa zitaendelea kutumika kwenye utafiti.

Je utampigia nani kuhusu utafiti huu?

Kama una maswali kuhusu utafiti au ukiwa na haja ya kuripoti athari zitokanazo na utafiti, unaweza kumpigia daktari wako au mwendesha utafiti huu: **Dr Nafsa R. Marombwa (0718984761)** muda wa masaa ya kazi. Kama una swali kuhusu haki zako kama mshiriki unaweza kuwasiliana na Profesa Mainen Moshi, Mkurugenzi wa Kamati ya Kitengo cha Utafiti, Chuo Kikuu Cha Sayansi na Tiba Cha Muhimbili, S.L.P 65001, Dar es Salaam, Namba ya Simu 2150302-6

Je kuna gharama juu ya tafiti huu?

Hakuna gharama kama utakubali kushiriki kwenye utafiti huu. Watafiti na Chuo kikuu cha Muhimbili watasaidia gharama zote za utafiti.

Je utalipwa kwa kushiriki kwenye utafiti?

Hapatakuwa na malipo kwako au mtoto wako kwa kushiriki kwenye utafiti. Kama utakubali kushiriki kwenye utafiti huu na ukasaini fomu hii ya ridhaa, haujiondolei haki

yoyote ya kisheria.

Ridhaa:

Nimesoma maelezo hapo juu kuhusu uchunguzi wa ulinganishi wa daraja za uchambuzi za nyumbani, Australia, Manchester, Canada na Afrika ya kusini katika kukadiria matokeo ya watoto wenye umri chini ya miaka mitano wenye malalamiko ya kiafya yasiyo ya majeraha wanaofika katika hospitali ya Taifa ya Muhimbili, kitengo cha dharura. Nimepewa muda wa kuuliza maswali na nimeelewa. Nakubali kushiriki katika utafiti huu na nimepewa nakala ya fomu hii ya ridhaailiyowekwa sahihi.

Sahihi:

---------- **----------**

Sahihi ya mtafiti au kaimu na tarehe Jina kamili

---------- ----------

Sahihi ya mshiriki au mwakilishi wa kisheria na tarehe Jina kamili

Study no: _____

13.3 APPENDIX III.

DATA COLLECTION SHEET.

ANY QUESTIONS CALL: Dr Nafsa 0718984761

ENROLE ANY CHILD WHO MEET ALL FOUR CRITERIA

A: Inclusion criteria	**Tick**
Age ≤5years?	
Non- traumatic medical complaints?	
Not in respiratory or cardiac arrest on arrival?	
Parents /care giver Agreed and signed a consent form?	
Not coming follow up.	

B: Demographics:

Initials ☐ MR number ☐ Date of presentation _____

Sex: ☐ Age: _____

Weight _____kg Height _____cm

Informant _____(relationship) Phone contact _____

Referral status(tick)

☐ Referred ☐ Self-referral

If referred, how many days stayed at periphery? ____days.

Birth history: ☐ Term ☐ Preterm ☐ Unknown:

Mode of delivery: ☐ SVD (hospital) ☐ SVD (home) ☐ CS

Immunization status: (as per age) (tick)

☐ Complete ☐ Incomplete ☐ Unknown

Study number:

Comorbidities: (tick)

☐ Unknown

☐ Sickle cell disease
☐ congenital heart disease
☐ HIV

Others (list):

_____
_____
_____

Nutritional status. (tick as per physician gestalt)
Normal ☐ Abnormal ☐

C: Presentation at triage:

Chief complaint:

1._____

2._____

3._____

4._____

5._____

Vital signs:

Temp: _____ (axillary /rectal) RR: _____ HR : _____ BP: _____

SpO2: _____ % (RA / NC /NRBM**)**

LTS: Triage level (tick as per triage nurse)

☐ **Emergency** ☐ **Priority** ☐ **Queue**

OTHER TRIAGE LEVELS(As per attached algorithm/ charts)

MTS ☐ Immediate ☐ Very urgent ☐ Urgent ☐ Standard ☐ Non urgent

ATS: ☐ Resuscitation ☐ Emergency ☐ Urgent ☐ Semi urgent ☐ Non urgent

CTAS: ☐ Resuscitation ☐ Emergency ☐ Urgent ☐ Less urgent ☐ Non urgent

SATS: ☐ Emergency ☐ Very urgent ☐ Urgent ☐ Routine.

Time seen by physician: _____

C: Chief complaints by physician.

1._____

2._____

3._____

4._____

D: Differential diagnoses by physician:

1._____

2._____

3._____

4._____

5._____

E: Investigations done at EMD (PoC) and its Results.

RBG: ☐ Y ☐ N Results:_____mmol/L

mRDT: ☐ Y ☐ N Results: _____

Urine dipstick: ☐ Y ☐ N Results: ☐ Nitrites ☐ proteins ☐ leucocytes ☐ ketones

Rapid HIV test: ☐ Y ☐ N Results: ☐ Reactive ☐ Non-reactive ☐ indeterminate

Cardiac ultrasound ☐ Results: ☐ Normal ☐ Abnormal

Pulmonary ultrasound ☐ Results: ☐ Normal ☐ Abnormal

CXR: ☐ Results: ☐ Normal ☐ Abnormal

Other investigations: (list)

1._____ Results: _____

2._____ Results: _____

3._____ Results: _____

F: Disposition:

☐ Admitted ☐ Discharged ☐ Died at EMD

If admitted where?

☐ Pediatric(medical) ☐ ICU

☐ Pediatric(surgical) ☐ Others:_____

☐ APCU Disposition time: _____

G: Follow up.

Is the patient alive after 24hrs of hospitalization?

☐ Yes ☐ No

If no: Date of death: _____

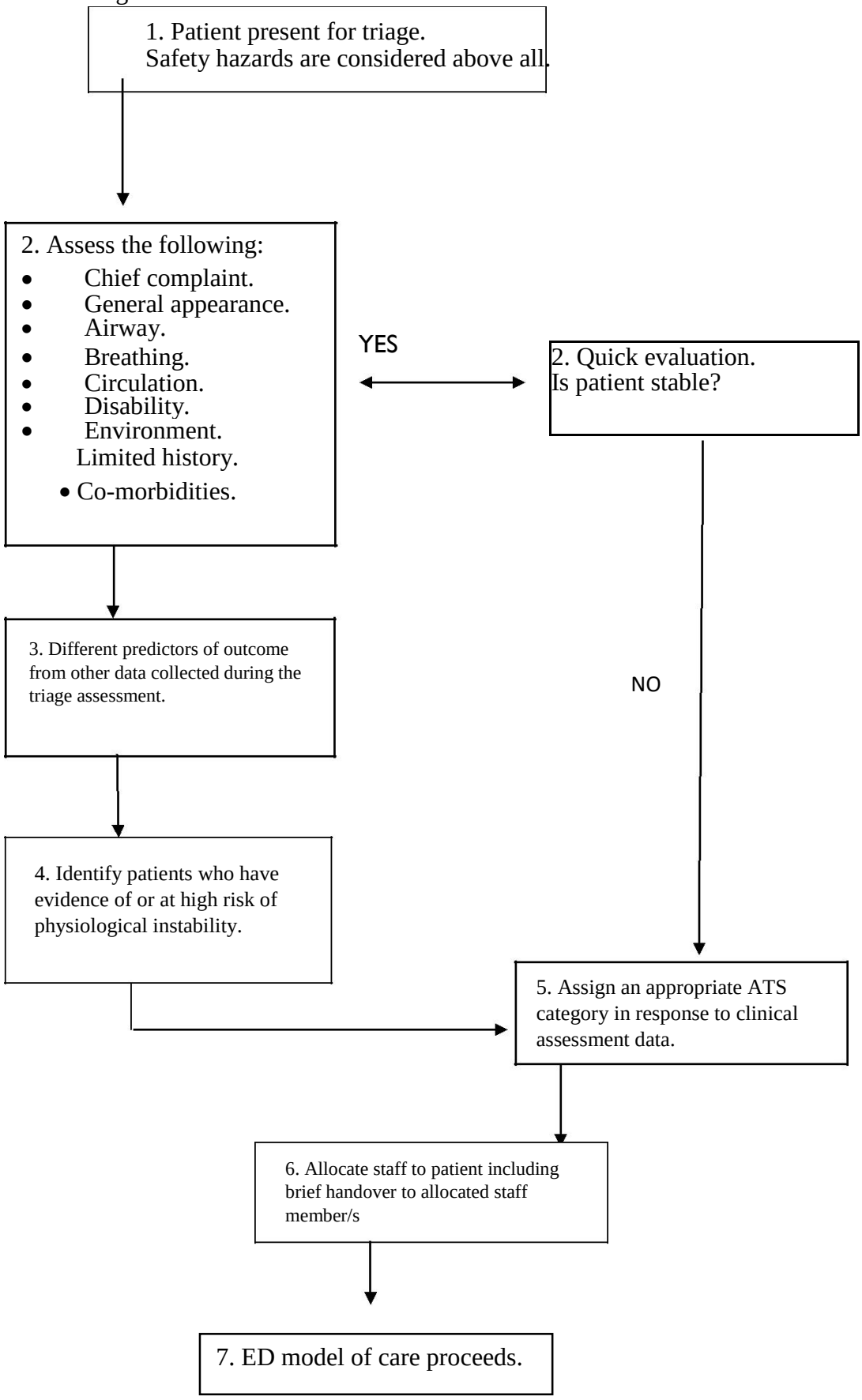
Duration of hospital stay:_____

==THE END==

THANK YOU!

13.4 AUSTRALASIAN TRIAGE SCALE: TRIAGE

ALGORITHM.
Recommended triage method.



2. Paediatric physiological discriminators.

Criteria	**Category 1** Immediate	**Category 2** Emergency Within 10 minutes	**Category 3** Urgent Within 30 minutes	**Category 4** Semi-urgent Within 60 minutes.	**Category 5** Non-urgent Within 120 minutes
Airway	Obstructed Partially obstructed with severe respiratory distress	Patent Partially obstructed with moderate respiratory distress	Patent Partially obstructed with mild respiratory distress	Patent	Patent
Breathing	Absent respiration or hypoventilation Severe respiratory distress, e.g. – severe use accessory muscles – severe retraction – acute cyanosis	Respiration present Moderate respiratory distress, e.g. – moderate use accessory muscles – moderate retraction	Respiration present Mild respiratory distress, e.g. – mild use accessory muscles – mild retraction	Respiration present No respiratory distress – no use accessory muscles – no retraction	Respiration No respiratory distress – no use accessory muscles – no retraction present
Circulation s/s dehydration cap refill <2 sec dry oral mucosa sunken eyes absent tears deep	Absent circulation Significant bradycardia, e.g. HR <60 in an infant Severe haemodynamic compromise, e.g. – absent peripheral pulses	– skin pale -Circulation present. -Moderate haemodynamic compromise, e.g.	– skin pink – Circulation present. Mild haemodynamic compromise, e.g. -palpable peripheral pulses – skin pale, warm – mild	Circulation present No haemodynamic compromise, e.g. – palpable peripheral	Circulation present No haemodynamic compromise, e.g. – palpable peripheral pulses

respirations thready/ weak pulse tachycardia reduced: LOC/activity tissue turgor urine output	– skin pale, cold, moist, mottled – significant tachycardia – Capillary refill >4 secs. Uncontrolled haemorrhage	– weak/thready brachial pulse – skin pale, cool, – moderate tachycardia – capillary refill 2-4 secs >6 s/s dehydration	tachycardia 3-6 s/s dehydration	pulses – skin pink, warm, dry <3 s/s dehydration	– skin pink, warm, dry No s/s dehydration
Disability	GCS<8 Severe decrease in activity, e.g. – no eye contact, – decreased muscle tone	GCS 9-12 Moderate decrease in activity, e.g. – lethargic – eye contact when disturbed	GCS >13 Normal GCS or no acute change to usual GCS. Mild decrease in activity, e.g. – quiet but eye contact – interacts with parents	Normal GCS or no acute change to usual GCS No alteration to activity, e.g. – playing – smiling	
	Severe pain, e.g. – patient/parents report severe pain – skin, pale, cool – alteration in vital signs – requests analgesia	Moderate pain, e.g. – patient/parents report moderate pain – skin, pale, warm – alteration in vital signs – requests analgesia	Mild pain, e.g. – patient/parents report mild pain – skin, pink, warm – no alteration in vital signs – requests analgesia	No or mild pain, e.g. – patient/parents report mild pain – skin, pink, warm – no alteration in vital signs – declines analgesia	

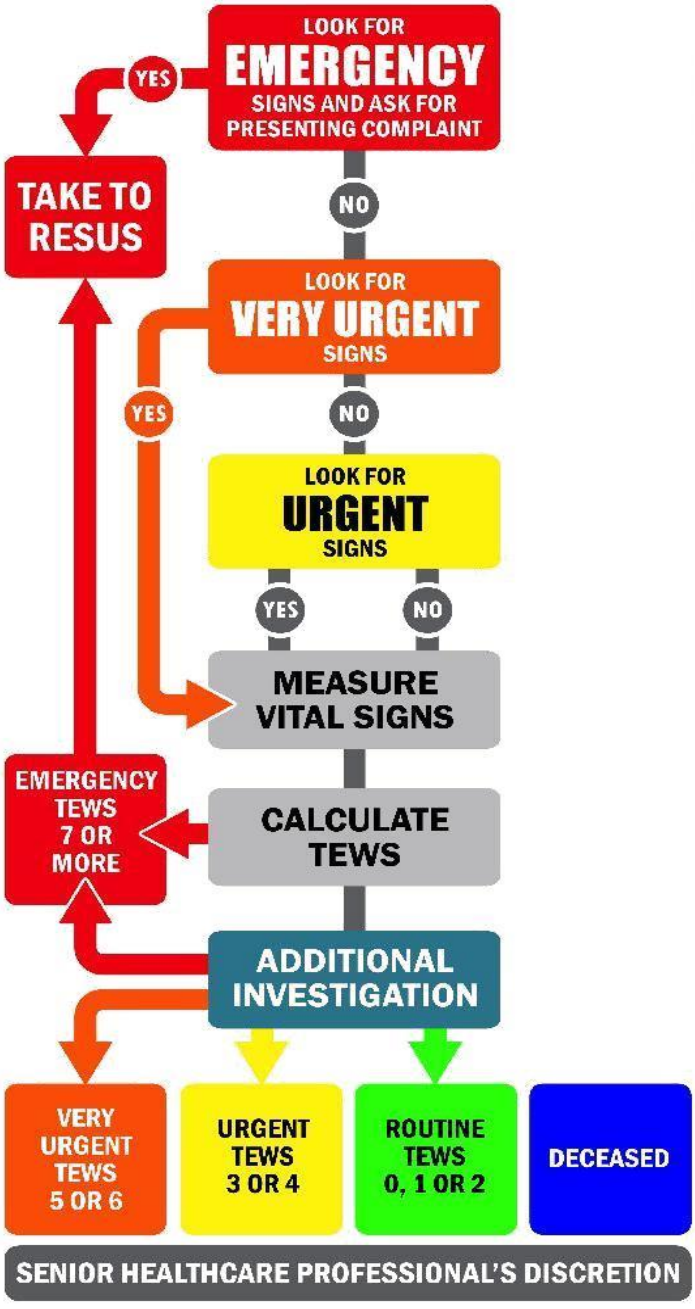
		Severe neurovascular compromise, e.g. – pulseless	Moderate neurovascular compromise, e.g. – pulse present	Mild neurovascular compromise, e.g. – pulse present	No neurovascular compromise
		– cold – nil sensation – nil movement – capillary refill	– cool – sensation – movement – capillary refill	– normal/ sensation – normal/ movement – normal capillary refill	

Risk factors for serious illness or injury

- These should be considered in the light of history of events and physiological data.
- Multiple risk factors = increased risk of serious injury.
- The presence of one or more risk factors may result in allocation of triage category of higher acuity.

Mechanism of injury, e.g.	**Co morbidities, e.g.**	**Age <3 months and**	**Historical variables, e.g.**	**Other, e.g.**
• Penetrating injury • fall>2-height • MCA>60kph • MBA/cyclist>30kph • Pedestrian • ejection/rollover • prolonged extrication (>30 minutes) • death same car occupant • Explosion.	• Hx prematurity • Respiratory disease • Cardiovascular disease • Renal disease • Carcinoma • Diabetes • Substance abuse • immuno-compromised • congenital disease • complex medical Hx	• Febrile • Acute change to feeding pattern • Acute change to sleeping pattern Victims of violence, e.g. • Child at risk • Sexual assault • Neglect	events preceding presentation to ED • apnoeic/cyanotic episode • seizure activity • decreased intake • decreased output • red currant jelly stool • bile stained vomiting • Parental concern	• Rash • actual/potential effects of drugs/alcohol • chemical exposure • envenomation • immersion • alteration in body temperature

13.5 SOUTH AFRICA TRIAGE SCALE: TRIAGE ALGORYTHM



PAEDIATRIC SATS CHART

Western Cape Government
Health

EMERGENCY	
Airway and Breathing	Not breathing or reported apnoea Obstructed breathing Central cyanosis or SpO_2 less than 92% Respiratory distress (severe)
Circulation	Cold hands + 2 or more of the following: (i) pulse weak and fast (ii) capillary refill time 3 sec or more (iii) lethargic Uncontrolled bleeding (not nosebleed)
Convulsions	Convulsing or immediately post-ictal and not alert
Coma	AVPU: Responds only to Pain (P) OR Unresponsive (U) Confusion
Dehydration	Diarrhoea or vomiting + 2 or more of the following: (i) Lethargy/floppy infant (ii) Very sunken eyes (iii) Skin pinch very slow - 2 sec or more
Other	Facial /inhalation burn Hypoglycaemia recorded at any time Glucose less than 3 mmol/L Purpuric rash

VERY URGENT	URGENT
Tiny baby - younger than 2 months	Some respiratory distress
Inconsolable crying/severe pain	Some Dehydration - Diarrhoea or Diarrhoea and vomiting + 1 or more of the following: (i) sunken eyes (ii) restless / irritable (iii) thirsty / decreased urine output (iv) dry mouth (v) crying without tears (vi) skin pinch slow-less than 2 sec
Presenting complaint - More sleepy than normal	
Poisoning or overdose	
Focal neurology acute	
Severe mechanism of injury	
Burns 10% or more (circumferential, electrical, chemical)	Unable to drink / feed OR vomits everything
	Malnutrition (visible severe wasting)
Eye injury	Malnutrition Oedema (pitting oedema of BOTH feet)
Fracture - open or threatened limb	Unwell child with known diabetes
	Any other burn less than 10%
Dislocation of larger joint (not finger or toe)	Closed fracture
	Dislocation of finger or toe

YOUNGER CHILD TEWS

	3	2	1	0	1	2	3
Mobility				Normal for age		Unable to move as normal	
RR	less than 20	20-25		26-39		40-49	50 or more
HR	less than 70	70-79		80-130		131-159	160 or more
Temp		Cold Under 35		35-38.4		Hot Over 38.4	
AVPU				Alert	Reacts to Voice	Reacts to Pain	Unresponsive
Trauma				No	Yes		

Younger than 3 years / smaller than 95cm

OLDER CHILD TEWS

	3	2	1	0	1	2	3
Mobility				Normal for age		Unable to walk as normal	
RR	less than 15	15-16		17-21	22-26	27 or more	
HR	less than 60	60-79		80-99	100-129	130 or more	
Temp		Cold Under 35		35-38.4		Hot Over 38.4	
AVPU		Confused		Alert	Reacts to Voice	Reacts to Pain	Unresponsive
Trauma				No	Yes		

3 to 12 years old / 96 to 150 cm tall

CHECK FOR ADDITIONAL INVESTIGATIONS	
If RR scores 1 point or more on TEWS	Check SpO_2 – if below 92% give O_2 and move to resus
Reduced level of consciousness (not alert, including more sleepy than normal)	Do a finger prick glucose test Hand over to senior health care professional (SHCP)
Unable to sit or move as normal for the child	Do finger prick glucose test
Diarrhoea	Start ORT
Vomiting only & dehydration	Hand over to SHCP
Malnutrition - visible severe wasting	Do finger prick glucose test
Malnutrition - with pitting oedema of BOTH feet	Do finger prick glucose test
History of diabetes:	Do a finger prick glucose test If below 3 mmol move to resus If 'HI' check with SHCP
History of bleeding: Bleeding PR, PO or from the site of trauma	Finger prick haemoglobin if 8 or less check with SHCP

13.6 CANADIAN TRIAGE AND ACUITY SCALE

The Canadian Association of Emergency Physicians
L'Association canadienne des médecins d'urgence

National Emergency Nurses Affiliation Inc.
L'affiliation nationale des infirmiers/infirmières d'urgence incorporée

L'association des Médecins d'urgence du Québec

The Canadian E.D. Triage and Acuity Scale

Patients should have an *INITIAL TRIAGE ASSESSMENT WITHIN 10 MINUTES** of arrival

TRIAGE LEVEL I - *RESUSCITATION*

Time to NURSE Assessment: *IMMEDIATE**
Time to PHYSICIAN Assessment: *IMMEDIATE**

USUAL PRESENTATION	SENTINEL DIAGNOSIS
Code / Arrest	Traumatic Shock
Major Trauma	Pneumothorax - Traumatic / Tension
Shock States	Facial Burns with Airway Compromise
Near Death Asthma	Severe Burns > 30% TBS
Severe Respiratory Distress	Overdose with Hypotension / Unconscious
Altered Mental State (unconscious, delerious)	AAA
Seizures	AMI with Complications / CHF / Low BP
	Status Asthmaticus
	Head Injury - Major / Unconscious
	Status Epilepticus

TRIAGE LEVEL II - *EMERGENT*

Time to NURSE Assessment: *IMMEDIATE**
Time to PHYSICIAN Assessment: *15 MINUTES**

USUAL PRESENTATION	SENTINEL DIAGNOSIS
Head Injury (Risk Features ± Altered Mental State)	Head Injury
Severe Trauma	Trauma, Multiple Sites, Multiple Rib Fracture, Neck Injury / Spinal Cord
Altered Mental State (lethargic, drowsy, agitated)	
Chemical Exposure - Eyes	Alkaline / Caustic Occular Burns
Allergic Reaction (Severe)	Anaphylaxis
Chest Pain • Visceral, Non-Traumatic	AMI, Unstable Angina, CHF, Chest Pain NOS,
• ± Associated Symptoms	Gastroesophageal Reflux
Overdose (conscious), Drug Withdrawal	Unspecified Drug / Medicinal Overdose, "d.t.'s"
ABD Pain (Age >50) with Visceral Symptoms	AAA, Appendicitis, Cholecystitis
Back Pain (Non Trauma, Not MSK)	
GI Bleed with Abnormal Vital Signs	Gastrointestinal Bleed, Hypotension
CVA with Major Deficit	CVA
Asthma Severe (PEFR <40%)	Severe Asthma
Moderate / Severe Dyspnea / Diffuculty Breathing	COPD, Croup
Vaginal Bleeding • Acute, Pain scale >5	Spontaneous Abortion
• ± Abnormal Vital Signs	Ectopic Pregnancy / Rupture
Vomiting and/or diarrhea (with suspicion of dehydration)	
Signs of serious infection (purpuric rash, toxic)	
Chemotherapy or immunocompromised	
Fever (age ≤ 3 months) Temp ≥ 38.0 (rectal)	Epiglottitis, Meningitis, Sepsis
Acute Psychotic Episode / Extreme Agitation	Acute Psychotic Episode / Agitation
Diabetes: Hypoglycemia, Hyperglycemia	Hypoglycemia, Diabetic Ketoacidosis, Hyperglycemia
Headache (Pain Scale 8 - 10/10)	Migraine
Pain Scale 8-10 (CVA, Back, Eye)	Renal Colic, LBP / Strain (Disc), Keratitis, Iritis
Sexual Assault	
Neonate (≤ 7 days old)	

TRIAGE LEVEL III - *URGENT*

Time to NURSE Assessment: *30 MINUTES**
Time to PHYSICIAN Assessment: *30 MINUTES**

USUAL PRESENTATION	SENTINEL DIAGNOSIS
Head Injury, Alert, Vomiting	Head Injury
Moderate Trauma	Anterior Dislocated Shoulder, Tibia / Fibula Fracture, Bimalleolar, Trimalleolar Ankle Fracture
Abuse / Neglect / Assault	
Vomiting and/or diarrhea (≤ 2 years)	
Dialysis problems	
Signs of Infection	Pyelonephritis
Mild / Moderate Asthma (PEFR > 40%)	Asthma without Status / COPD
Mild / Moderate Dyspnea	Bronchiolitis / Croup, Pneumonia
Chest Pain • No Visceral Symptoms (Sharp/MSK)	Chest Pain NOS (MSK, GI, Resp)
• No Previous Heart Disease	
GI Bleed with Normal Vital Signs	GI Bleed, No complications
Vaginal Bleeding Acute, Normal Vital Signs	Spontaneous Abortion
Seizure, Alert on Arrival	Seizure
Acute Psychosis ± Suicidal Ideation	Acute Psychosis ± Suicidal Ideation
Pain Scale 8 - 10 / 10 with minor injuries	
Pain Scale 4 - 7 / 10 (Headache, CVA, Back)	Migraine, Renal Colic, LBP / Strain (Disc)

TRIAGE LEVEL IV - *LESS URGENT*

Time to NURSE Assessment: *60 MINUTES**
Time to PHYSICIAN Assessment: *60 MINUTES**

USUAL PRESENTATION	SENTINEL DIAGNOSIS
Head Injury, Alert, No Vomiting	Head Injury, Alert, No Vomiting
Minor Trauma	Colles Fracture, Ankle Sprain
ABD Pain (Acute)	Appendicitis, Cholecystitis
Earache	Otitis Media / Otitis Extema
Chest Pain, Minor Trauma or MSK, No Distress	Chest Pain NOS (MSK, GI, Resp), Gastroesophageal Reflux
Vomiting and diarrhea (>2 years/no dehydration)	
Suicidal Ideation / Depression	Suicidal Ideation / Depression
Allergic Reaction (Minor)	Urticaria
Corneal Foreign Body	Corneal Foreign Body
Back Pain (Chronic)	LBP /Strain
URI Symptoms	URI
Pain Scale 4 - 7	
Headache (Non Migraine / Not Sudden)	

TRIAGE LEVEL V - *NON URGENT*

Time to NURSE Assessment: *120 MINUTES**
Time to PHYSICIAN Assessment: *120 MINUTES**

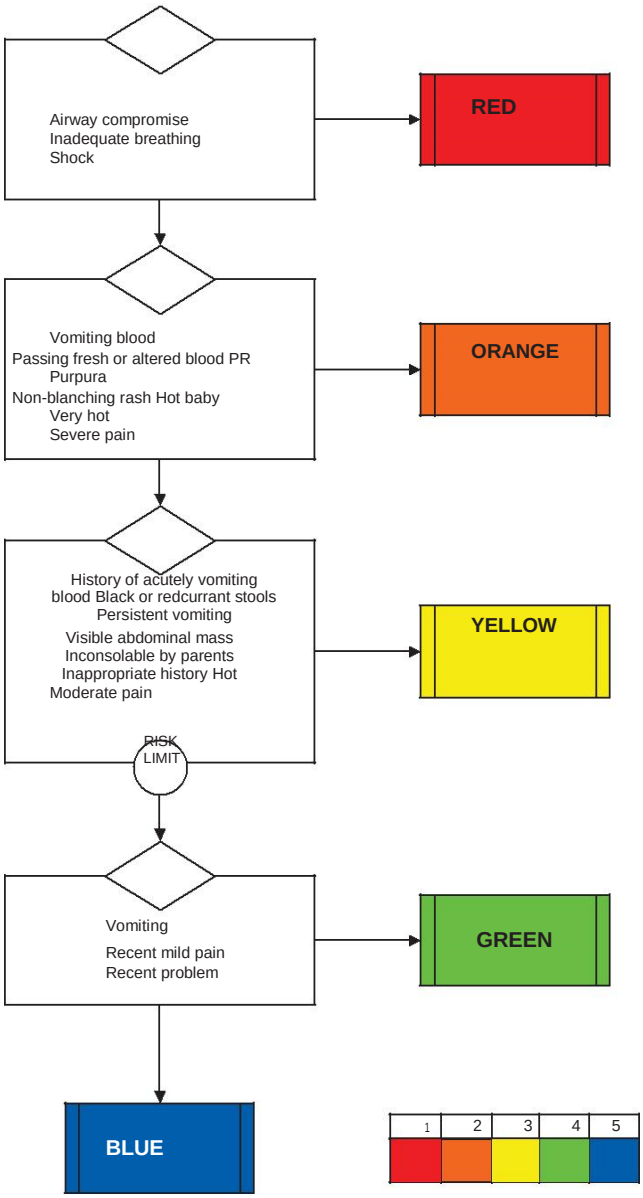
USUAL PRESENTATION	SENTINEL DIAGNOSIS
Minor Trauma, Not Necessarily Acute	LBP / Strain
Sore Throat, No Resp Symptoms	URI
Diarrhea alone (no dehydration)	Gastroenteritis
Vomiting alone normal mental status (no dehydration)	Vomiting
Menses	Disorders of Menstruation
Minor Symptoms	Dressing Changes
ABD Pain (Chronic)	Cast Changes
	Constipation

13.7 MANCHESTER TRIAGE SCALE GENERAL DISCRIMINATORS

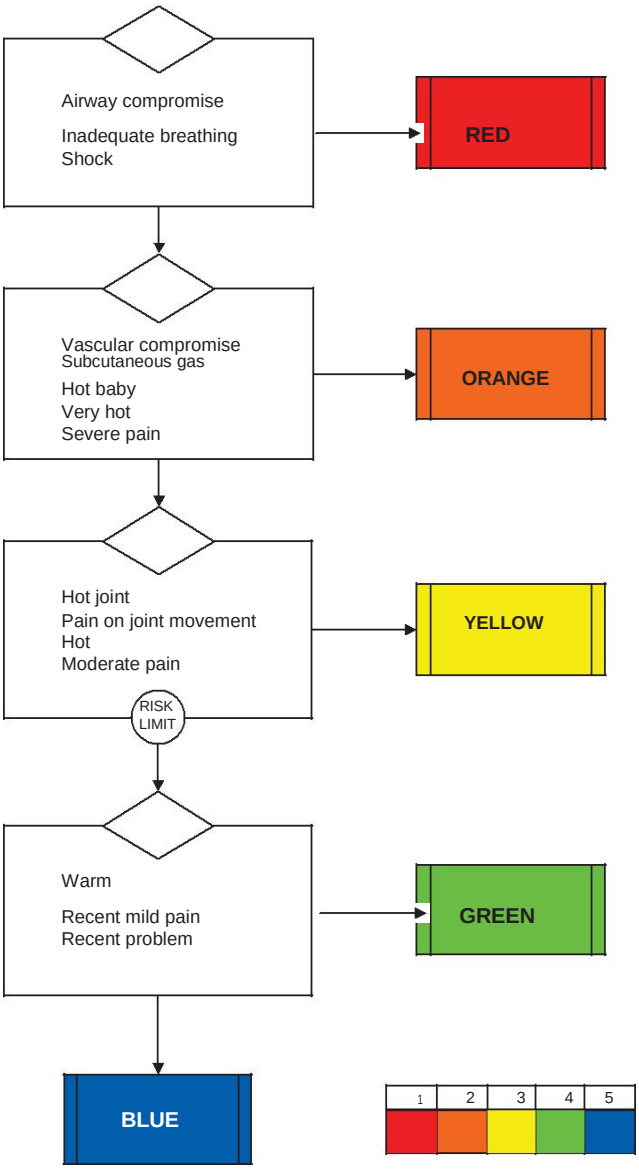
General discriminator.	Explanation.
Airway compromise	An airway may be compromised either because it cannot be kept open or because the airway protective reflexes (that stop inhalation) have been lost. Failure to keep the airway open will result in either intermittent total obstruction or in partial obstruction. This will manifest itself as snoring or bubbling sounds during breathing.
Inadequate breathing	Patients who are failing to breath well enough to maintain adequate oxygenation have inadequate breathing. There may be an increased work of breathing, signs of inadequate breathing or exhaustion.
Exsanguinating haemorrhage.	Haemorrhage which is occurring at such a rate that death will ensue unless bleeding is stopped.
Shock	Shock is inadequate delivery of oxygen to the tissues. The classic signs include sweating, pallor, tachycardia, hypotension and reduced conscious level.
Unresponsive child	A child who fails to respond to either verbal or painful stimuli.
Currently fitting	Patients who are in the tonic stages of a grand mal convulsion, and patients currently experiencing partial fits.
Altered conscious level.	Not fully alert. Either responding to voice or pain or unresponsive.
Responds to pain	Response to a painful stimulus. Standard peripheral stimuli should be used-a pencil or pen is used to apply pressure to the finger nail bed. This stimulus should not be applied to the toes since a spinal reflex may cause flexion even in brain death. Supraorbital ridge pressure should not be used since reflex grimacing may occur.
Responds to voice	Response to vocal stimulus. It is not necessary to shout the patient's name. Children may fail to respond because they are afraid.
Uncontrollable major haemorrhage	A haemorrhage that is not rapidly controlled by the application of a sustained direct pressure and in which blood continues to flow heavily or soak through large dressings quickly.
Very hot	If the skin feels very hot the patient is clinically said to be very hot. The temperature should be taken as soon as possible- a temperature of 41° C or greater is very hot.
Hot baby	If the skin is hot, the child is clinically said to be hot. The temperature should be taken as soon as possible- a temperature of 38.5° C and greater is hot. A baby is a child less than 1year old.
Cold	If the skin feels cold the patient is clinically said to be cold. The temperature should be taken as soon as possible- a core temperature less than 35° C is cold.
Severe pain	Pain that is unbearable- often described as the worst ever.
Uncontrolled minor haemorrhage	A haemorrhage that is not rapidly controlled by the application of sustained direct pressure and in which blood continues to flow slightly or ooze.

History of unconsciousness	There may be a reliable witness who can state whether the patient was unconscious (and for how long). If not, a patient who is unable to remember the incident should be assumed to have been unconscious.
Hot	If the skin feels warm the patient is clinically said to be warm. The temperature should be taken as soon as possible- a temperature greater than 37.5° C is warm.
Recent mild pain	Any pain that has occurred within the past / days.
Recent problem	A problem arising in the last week.

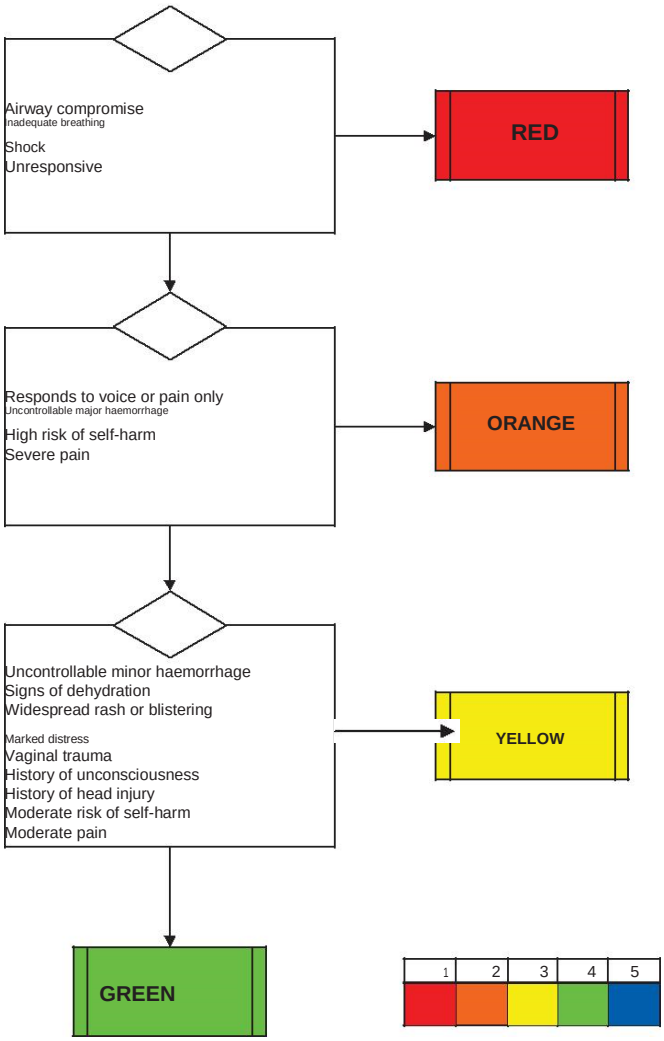
Abdominal pain in children



Abscesses and local infections

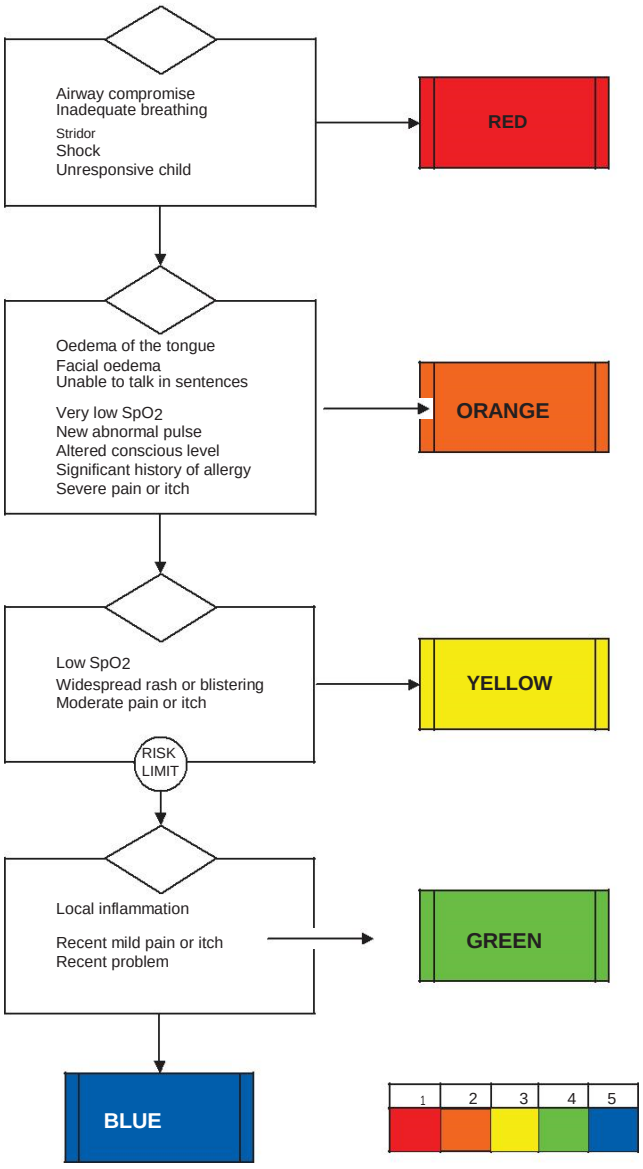


Abused or neglected child

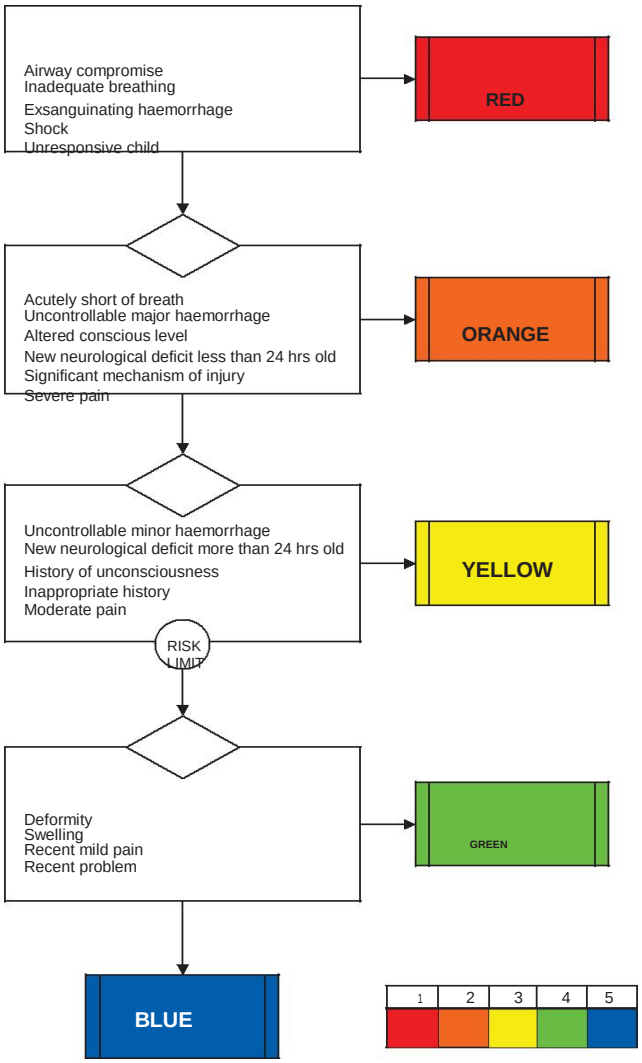


Notes accompanying abused or neglected child

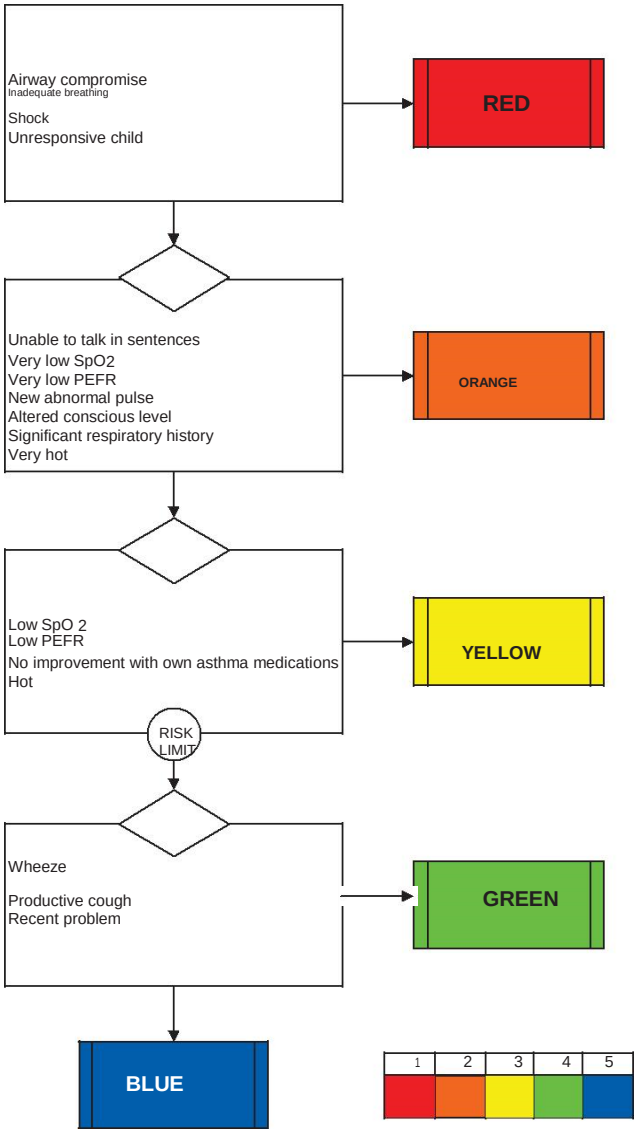
Allergy


Airway compromise
Inadequate breathing
Stridor
Shock
Unresponsive child
RED
Oedema of the tongue
Facial oedema
Unable to talk in sentences
Very low SpO2
New abnormal pulse
Altered conscious level
Significant history of allergy
Severe pain or itch
ORANGE
Low SpO2
Widespread rash or blistering
Moderate pain or itch
YELLOW
RISK LIMIT
Local inflammation
Recent mild pain or itch
Recent problem
GREEN
BLUE
1
2
3
4
5

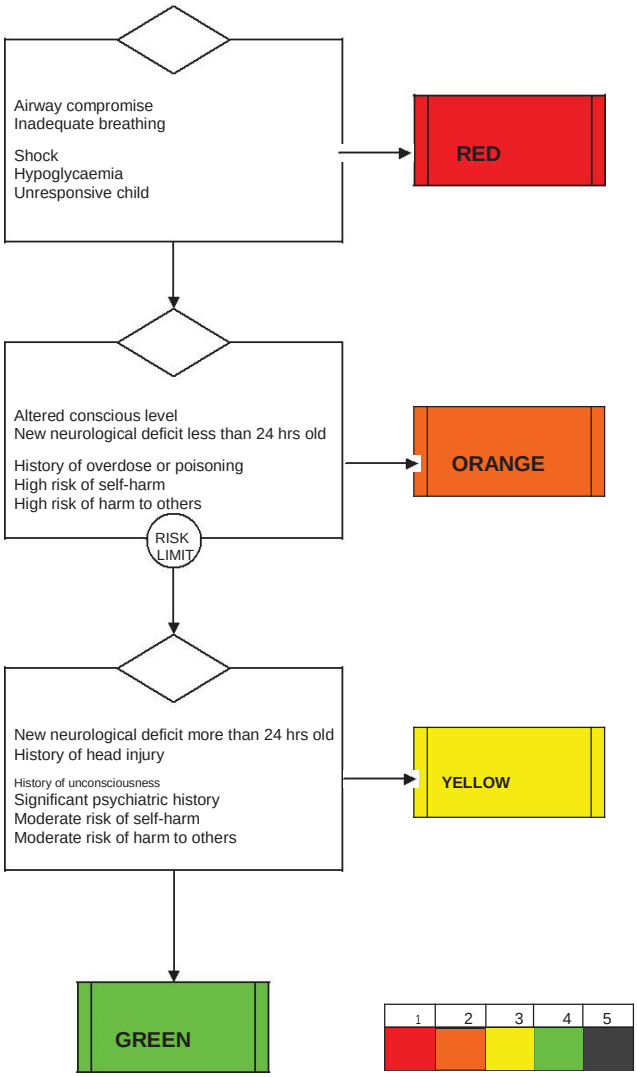
Assault


Airway compromise
Inadequate breathing
Exsanguinating haemorrhage
Shock
Unresponsive child
RED
Acutely short of breath
Uncontrollable major haemorrhage
Altered conscious level
New neurological deficit less than 24 hrs old
Significant mechanism of injury
Severe pain
ORANGE
Uncontrollable minor haemorrhage
New neurological deficit more than 24 hrs old
History of unconsciousness
Inappropriate history
Moderate pain
YELLOW
RISK LIMIT
Deformity
Swelling
Recent mild pain
Recent problem
GREEN
BLUE
1
2
3
4
5

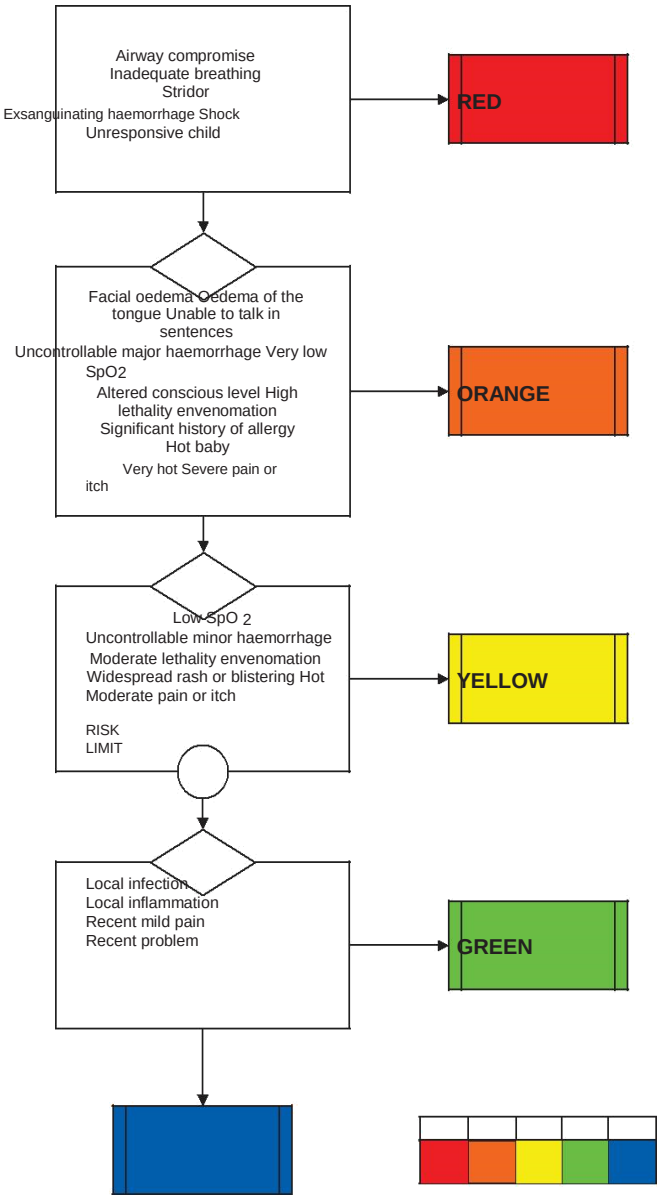
Asthma


Airway compromise
Inadequate breathing
Shock
Unresponsive child
RED
Unable to talk in sentences
Very low SpO2
Very low PEFR
New abnormal pulse
Altered conscious level
Significant respiratory history
Very hot
ORANGE
Low SpO 2
Low PEFR
No improvement with own asthma medications
Hot
YELLOW
RISK
LIMIT
Wheeze
Productive cough
Recent problem
GREEN
BLUE
1
2
3
4
5

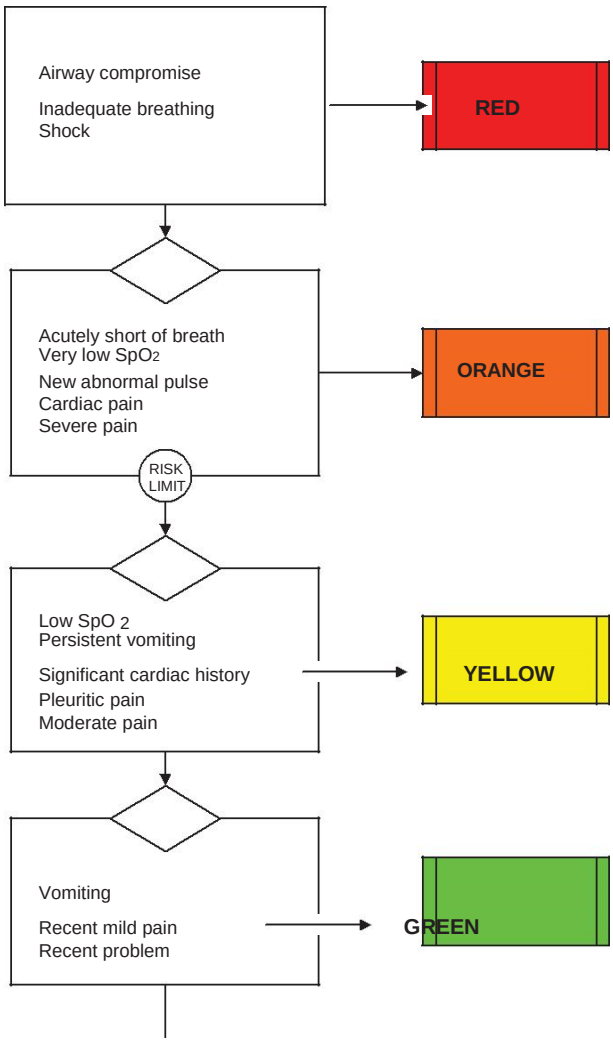
Behaving strangely



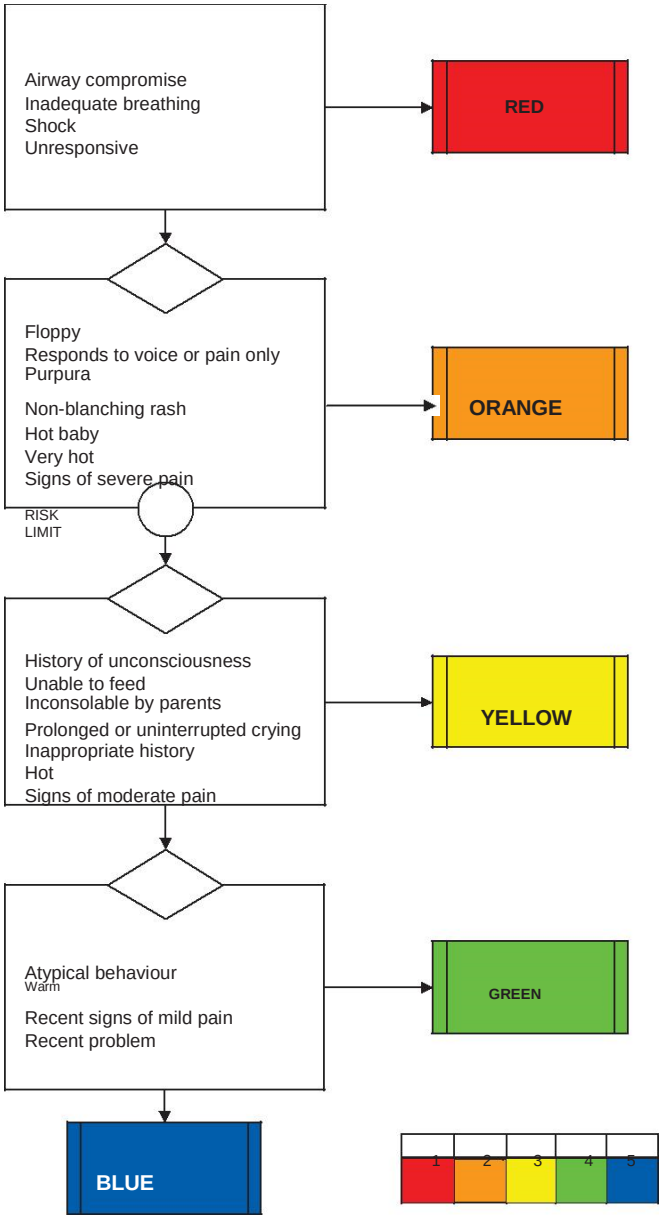
Bites and stings



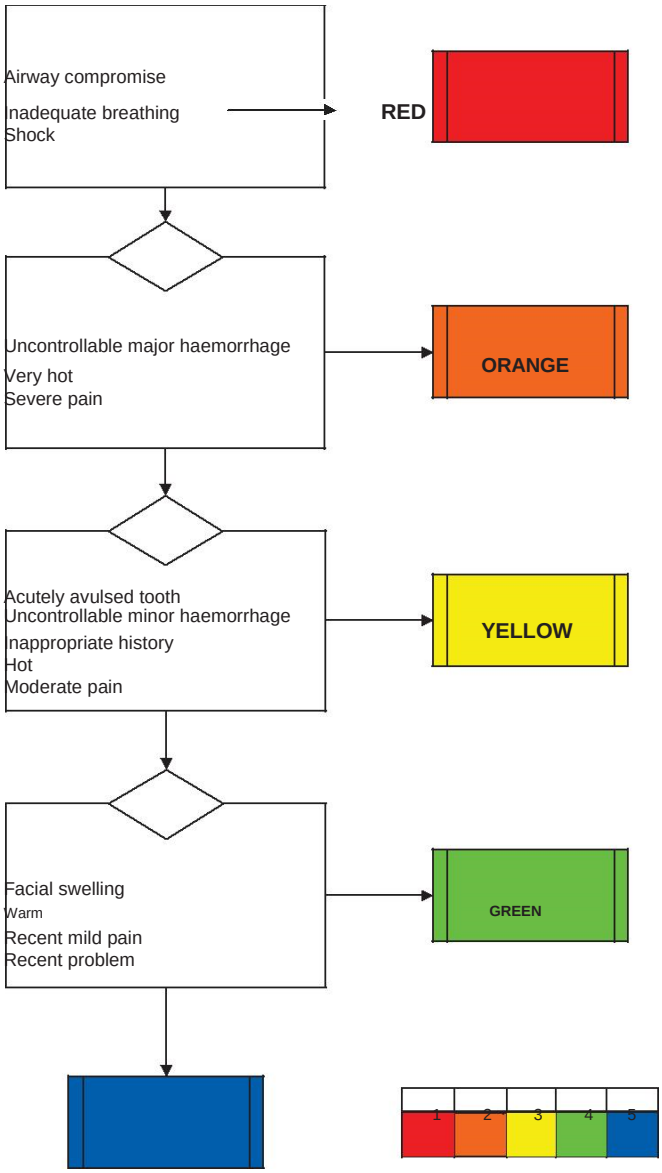
Chest pain


Airway compromise
Inadequate breathing
Shock
RED
Acutely short of breath
Very low SpO2
New abnormal pulse
Cardiac pain
Severe pain
ORANGE
RISK LIMIT
Low SpO 2
Persistent vomiting
Significant cardiac history
Pleuritic pain
Moderate pain
YELLOW
Vomiting
Recent mild pain
Recent problem
GREEN

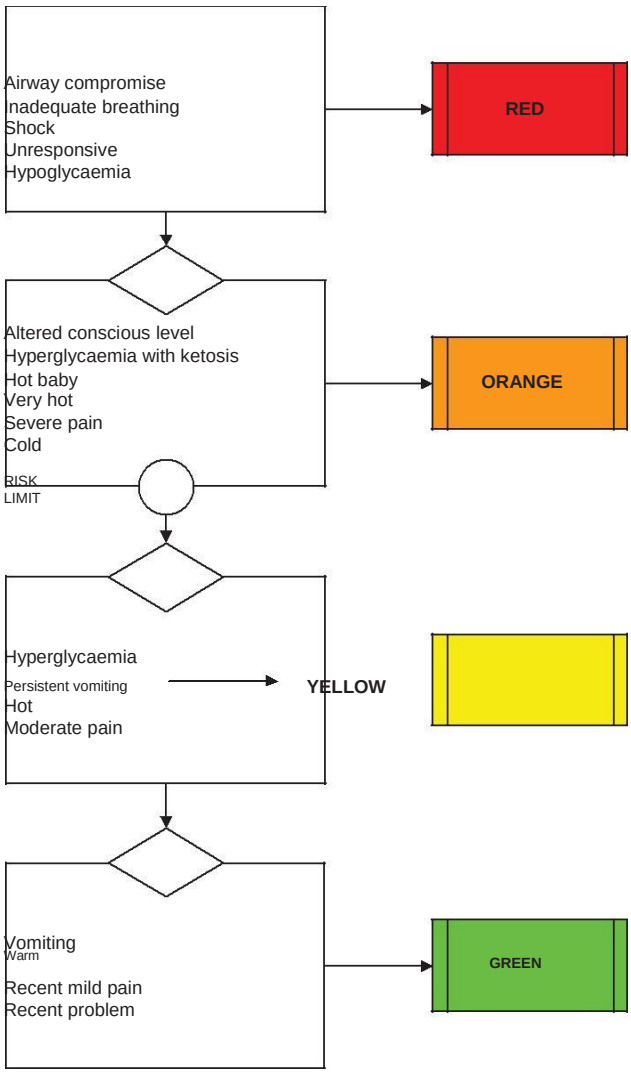
Crying baby


Airway compromise
Inadequate breathing
Shock
Unresponsive
RED
Floppy
Responds to voice or pain only
Purpura
Non-blanching rash
Hot baby
Very hot
Signs of severe pain
ORANGE
RISK
LIMIT
History of unconsciousness
Unable to feed
Inconsolable by parents
Prolonged or uninterrupted crying
Inappropriate history
Hot
Signs of moderate pain
YELLOW
Atypical behaviour
Warm
Recent signs of mild pain
Recent problem
GREEN
BLUE
1
2
3
4
5

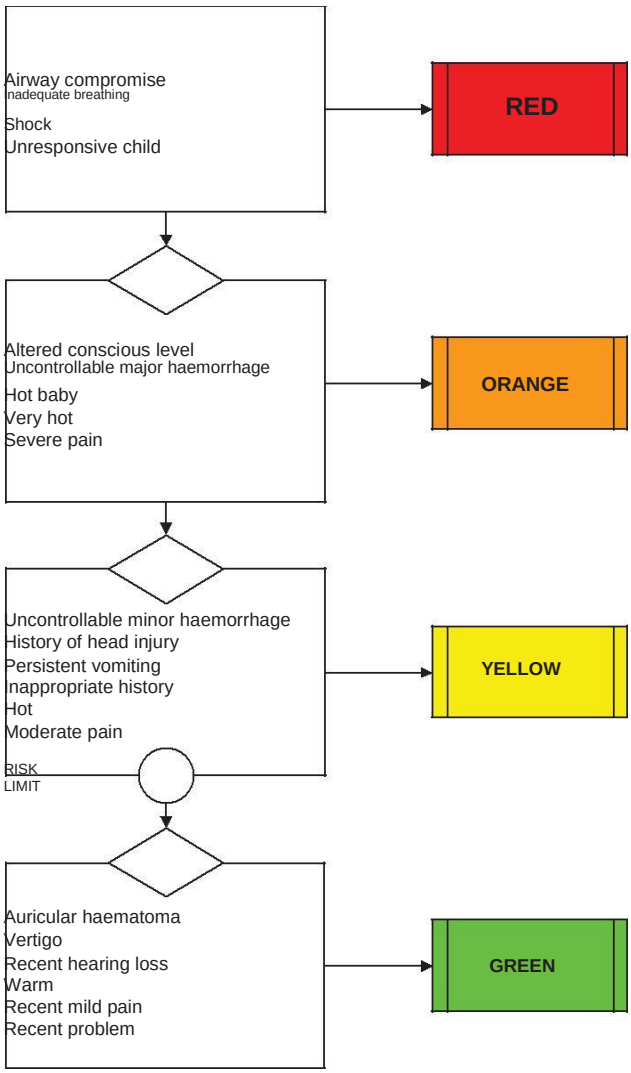
Dental problems



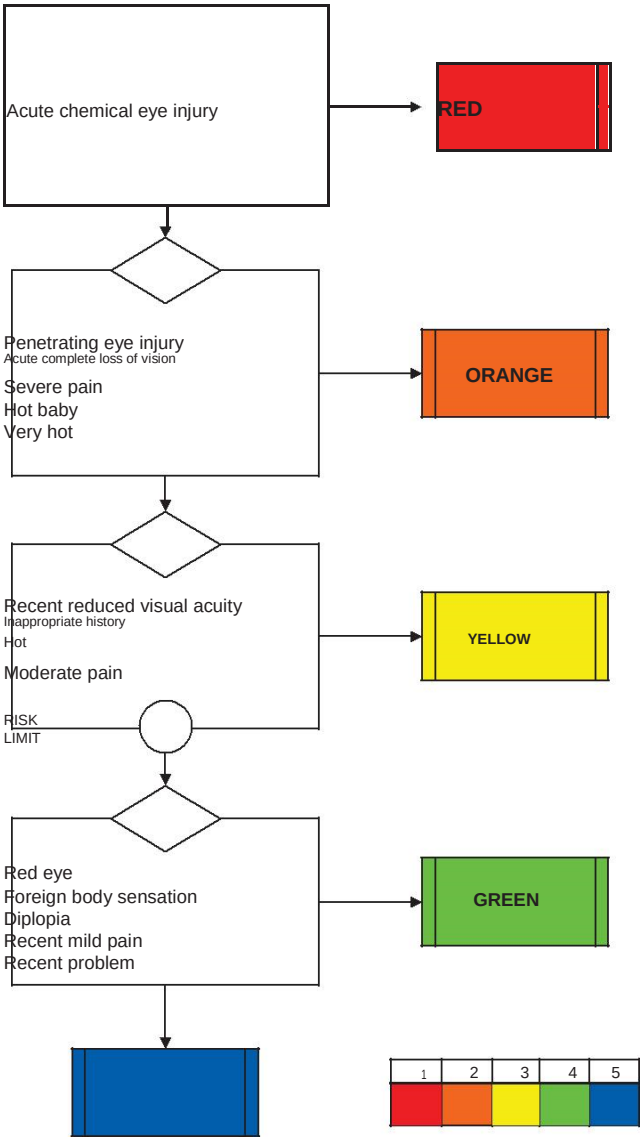
Diabetes


Airway compromise
Inadequate breathing
Shock
Unresponsive
Hypoglycaemia
RED
Altered conscious level
Hyperglycaemia with ketosis
Hot baby
Very hot
Severe pain
Cold
ORANGE
RISK
LIMIT
Hyperglycaemia
Persistent vomiting
Hot
Moderate pain
YELLOW
Vomiting
Warm
Recent mild pain
Recent problem
GREEN

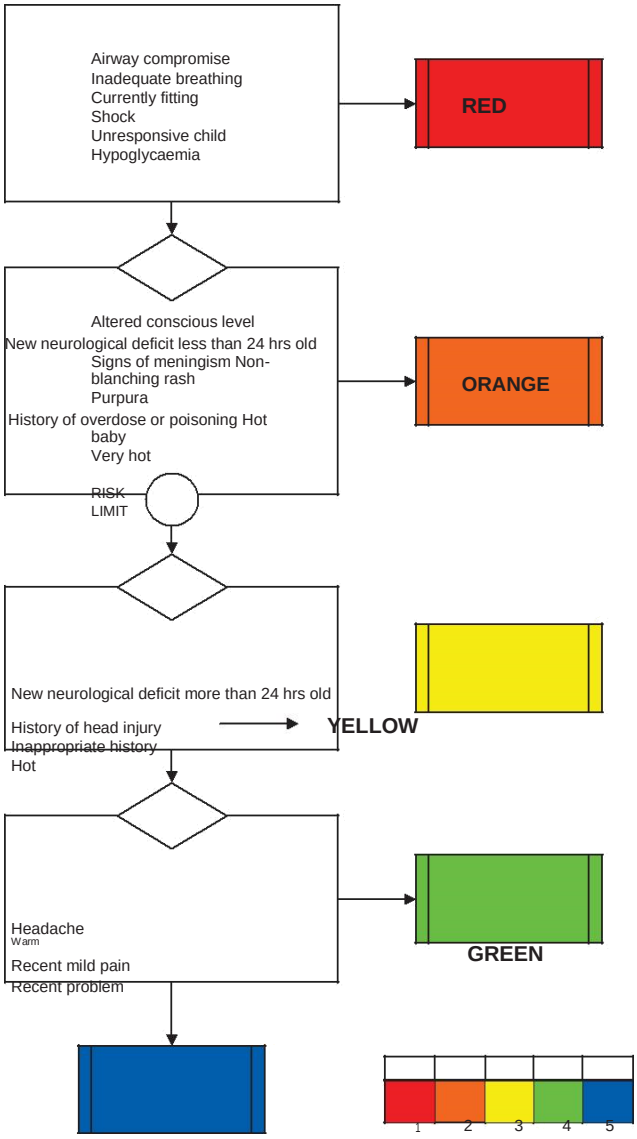
Ear problems



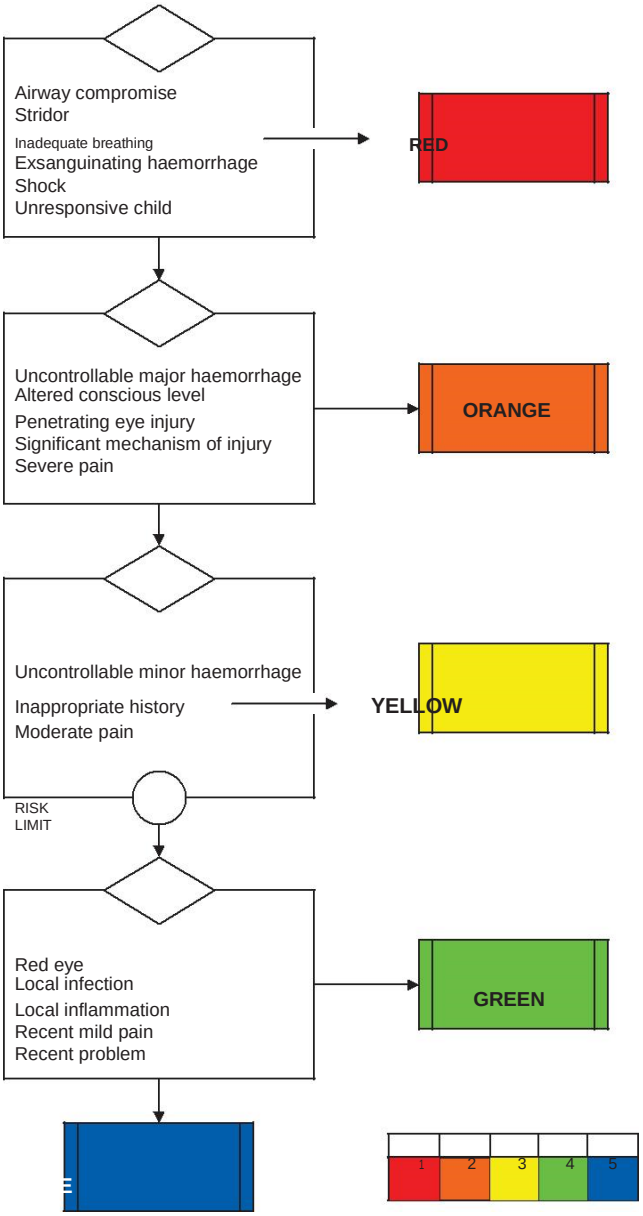
Eye problems



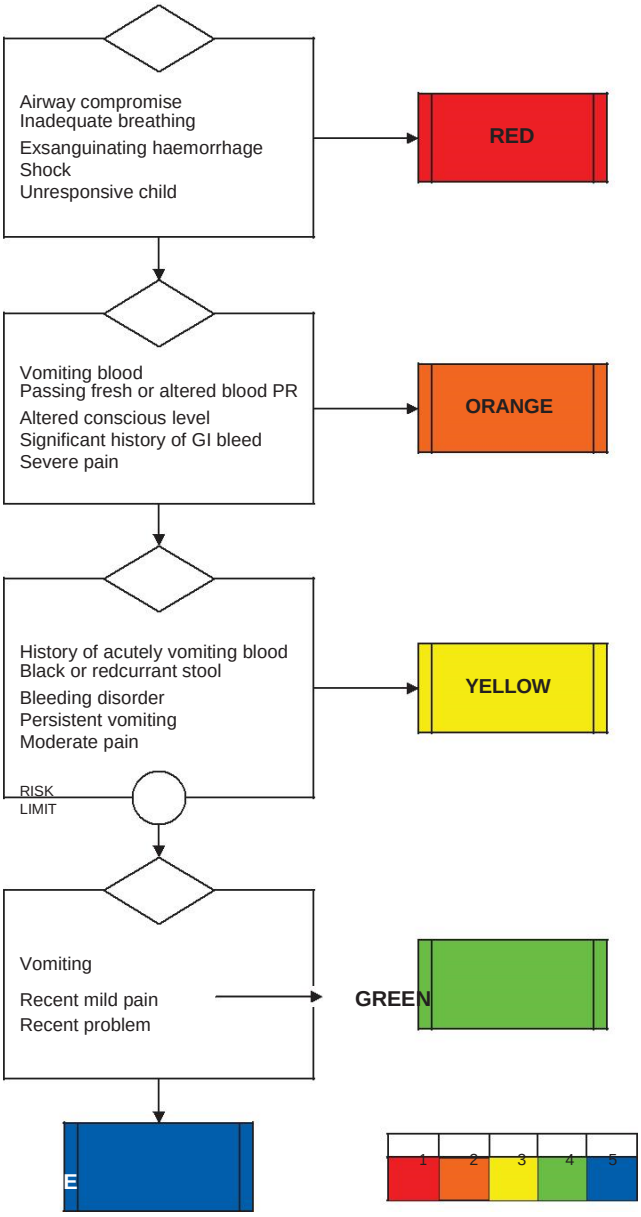
Fits


Airway compromise
Inadequate breathing
Currently fitting
Shock
Unresponsive child
Hypoglycaemia
RED
Altered conscious level
New neurological deficit less than 24 hrs old
Signs of meningism Non-blanching rash
Purpura
History of overdose or poisoning Hot baby
Very hot
ORANGE
RISK LIMIT
New neurological deficit more than 24 hrs old
History of head injury
Inappropriate history
Hot
YELLOW
Headache
Warm
Recent mild pain
Recent problem
GREEN
1
2
3
4
5

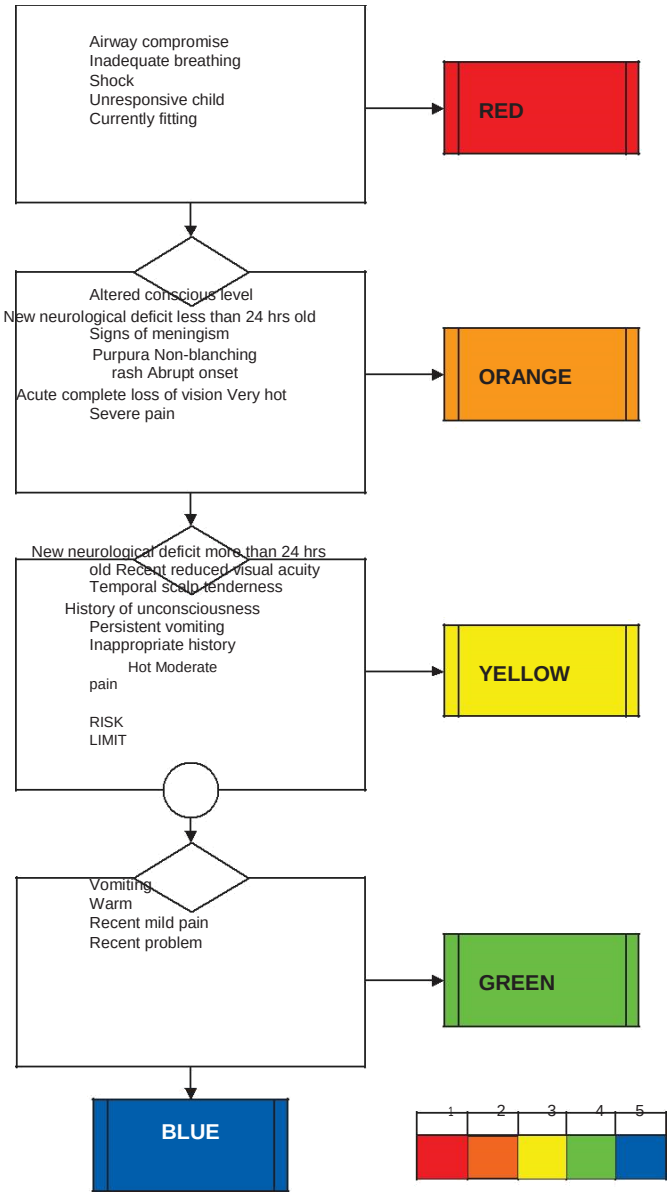
Foreign body



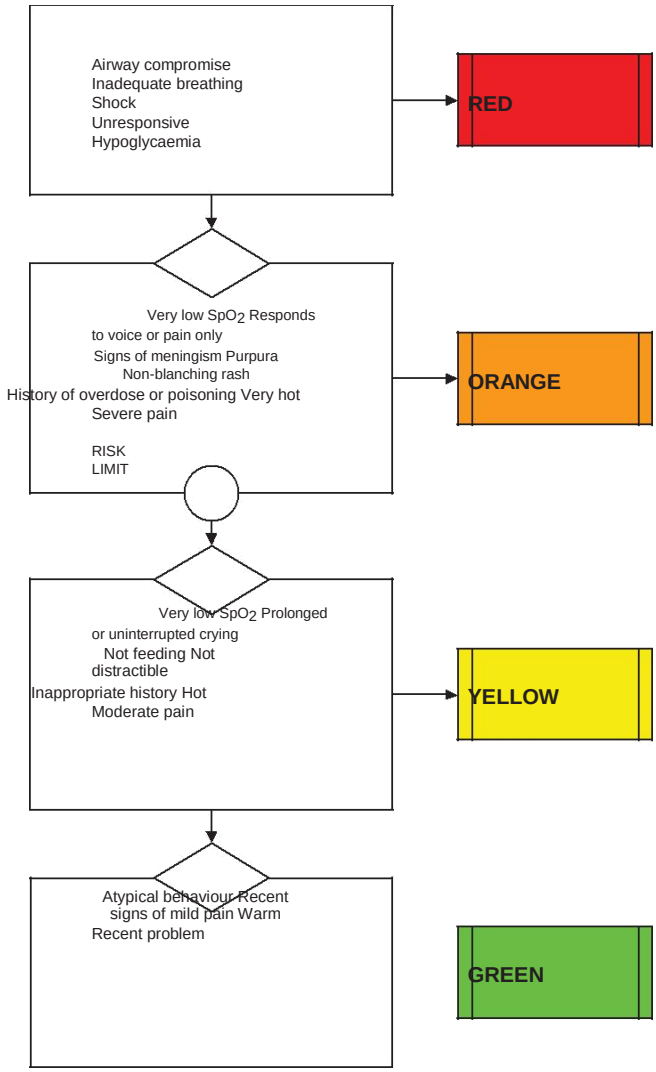
GI bleeding


Airway compromise
Inadequate breathing
Exsanguinating haemorrhage
Shock
Unresponsive child
RED
Vomiting blood
Passing fresh or altered blood PR
Altered conscious level
Significant history of GI bleed
Severe pain
ORANGE
History of acutely vomiting blood
Black or redcurrant stool
Bleeding disorder
Persistent vomiting
Moderate pain
YELLOW
RISK
LIMIT
Vomiting
Recent mild pain
Recent problem
GREEN
E
1
2
3
4
5

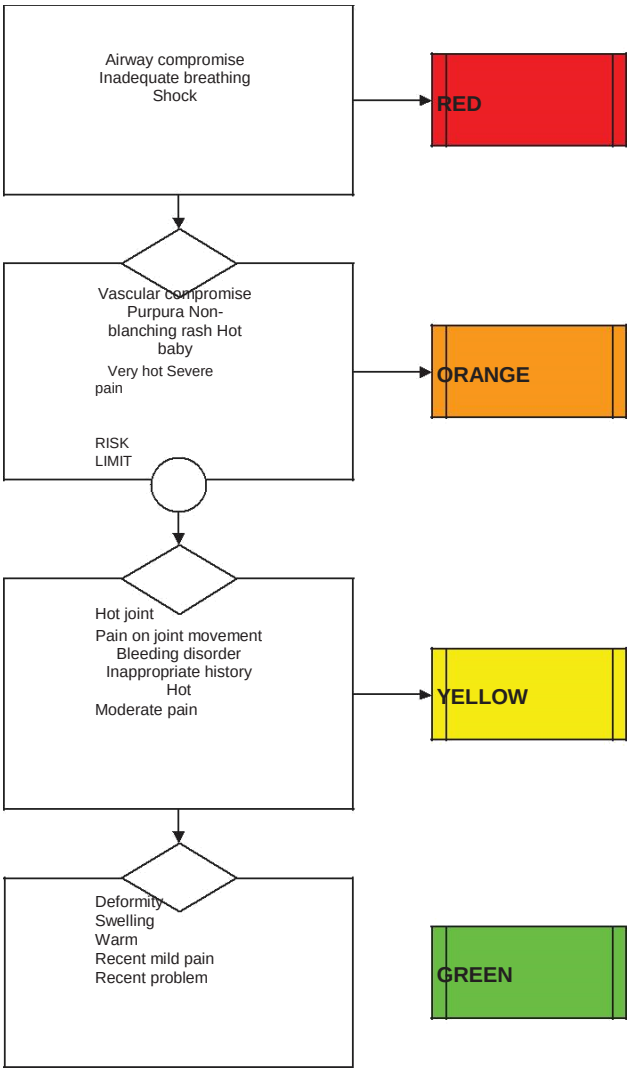
Headache


Airway compromise
Inadequate breathing
Shock
Unresponsive child
Currently fitting
RED
Altered conscious level
New neurological deficit less than 24 hrs old
Signs of meningism
Purpura Non-blanching rash Abrupt onset
Acute complete loss of vision Very hot
Severe pain
ORANGE
New neurological deficit more than 24 hrs
old Recent reduced visual acuity
Temporal scalp tenderness
History of unconsciousness
Persistent vomiting
Inappropriate history
Hot Moderate pain
RISK
LIMIT
YELLOW
Vomiting
Warm
Recent mild pain
Recent problem
GREEN
BLUE
1
2
3
4
5

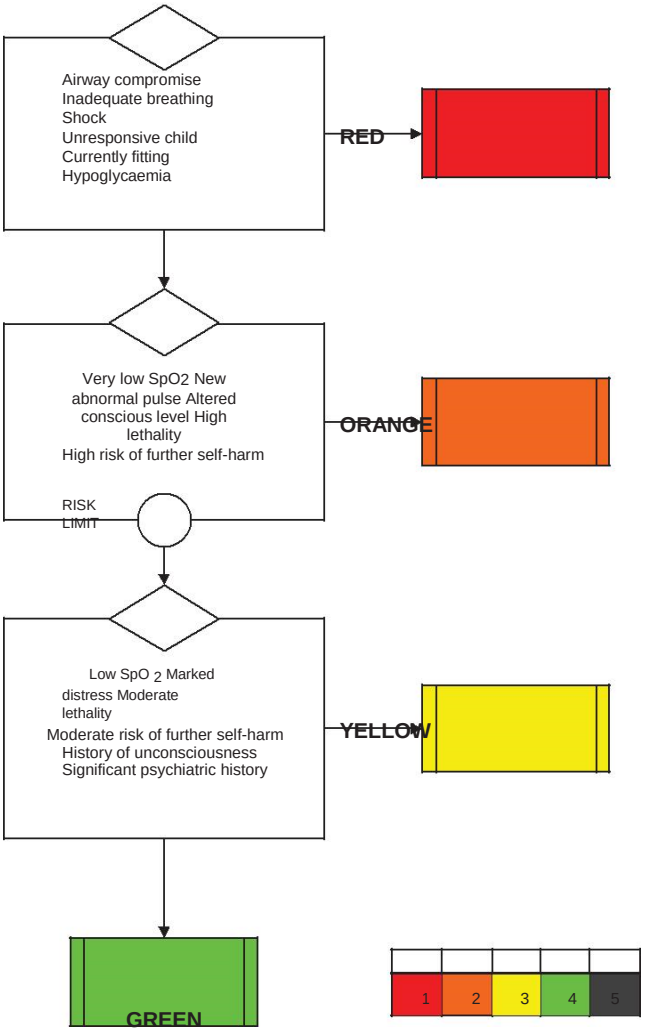
Irritable child



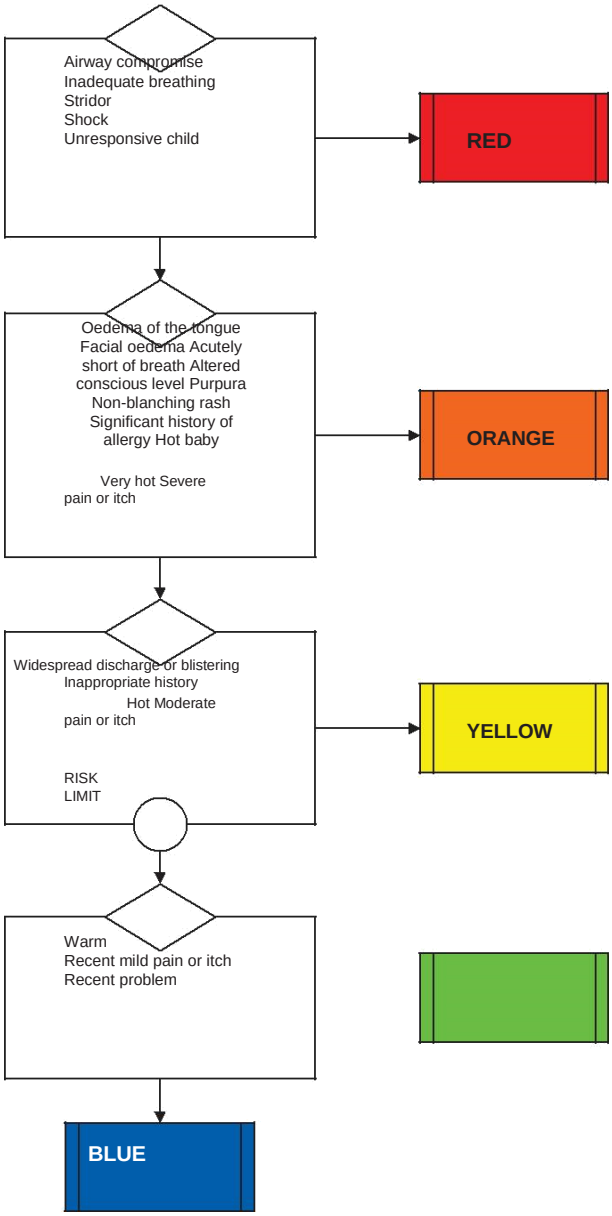
Limping child



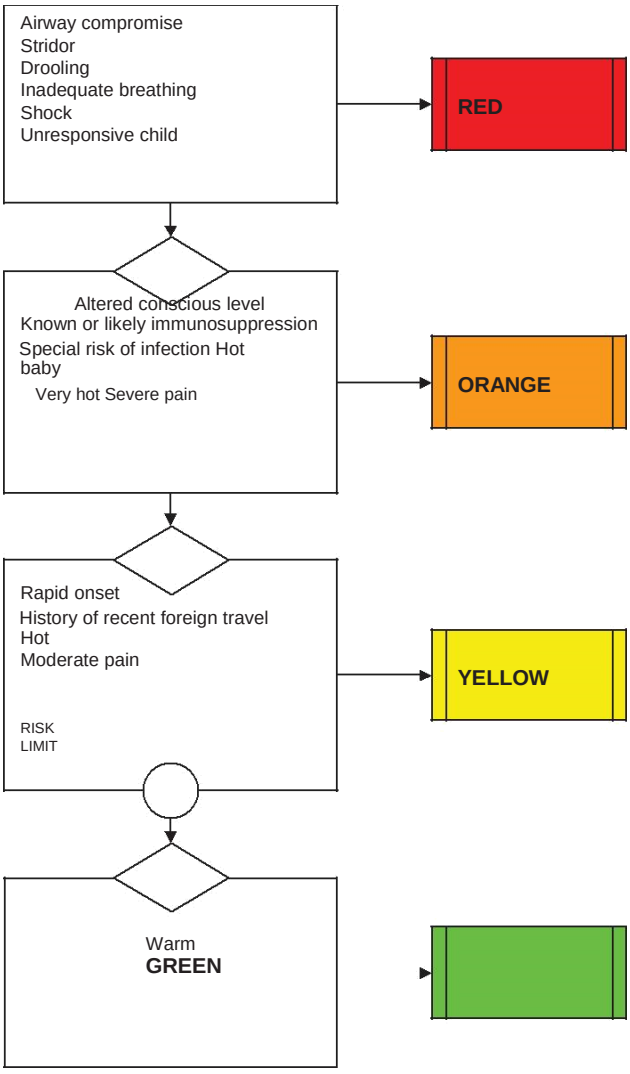
Overdose and poisoning



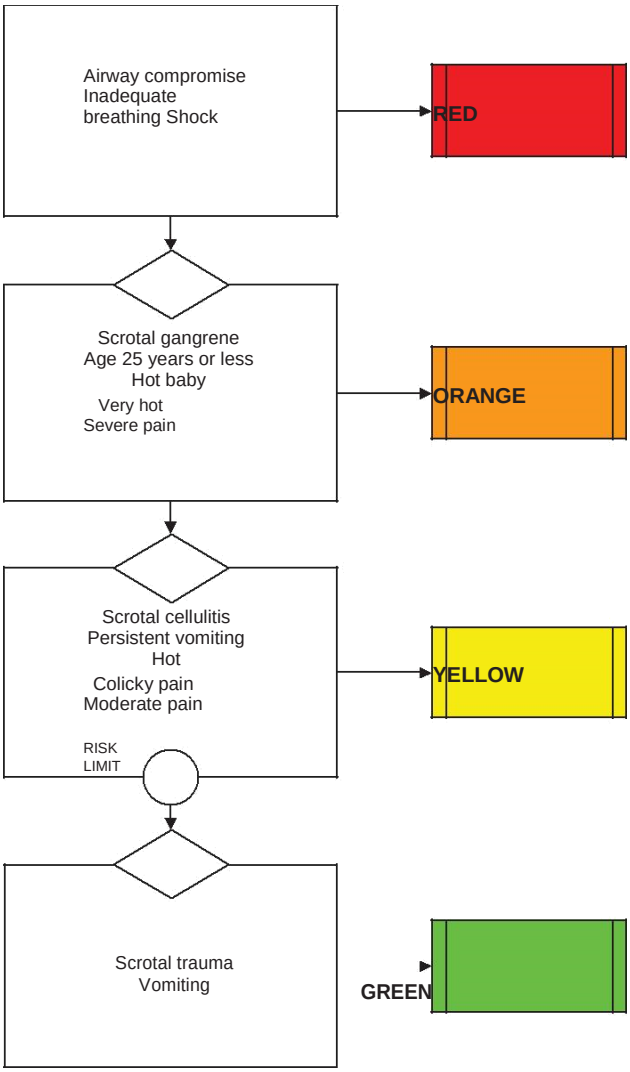
Rashes


Airway compromise
Inadequate breathing
Stridor
Shock
Unresponsive child
RED
Oedema of the tongue
Facial oedema Acutely
short of breath Altered
conscious level Purpura
Non-blanching rash
Significant history of
allergy Hot baby
Very hot Severe
pain or itch
ORANGE
Widespread discharge or blistering
Inappropriate history
Hot Moderate
pain or itch
YELLOW
RISK
LIMIT
Warm
Recent mild pain or itch
Recent problem
BLUE

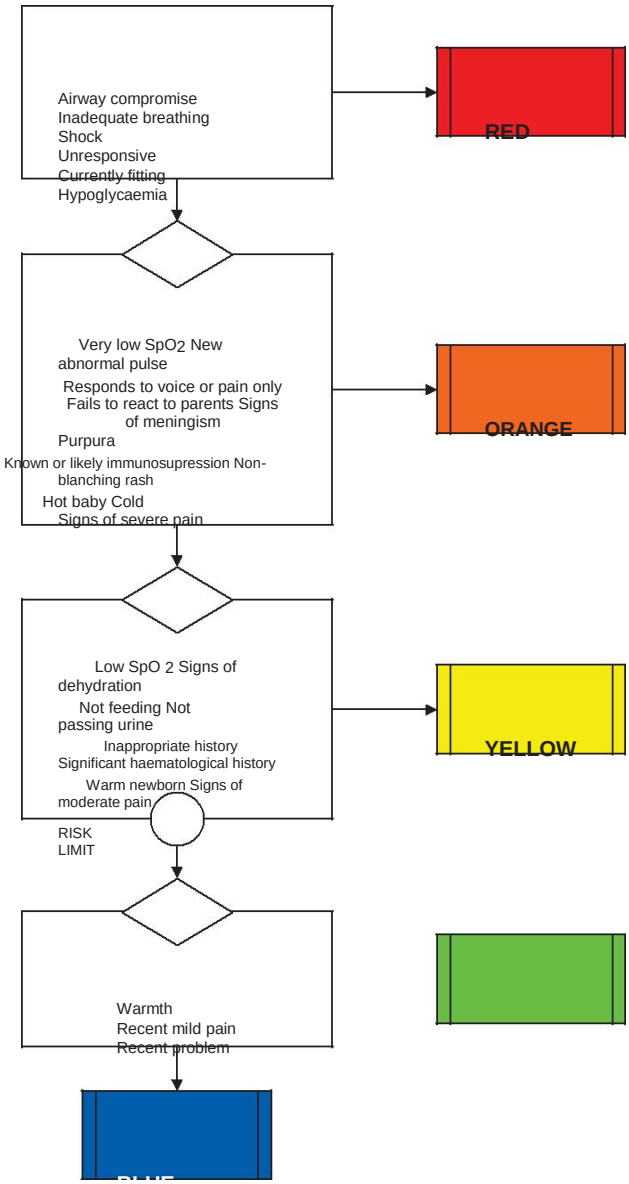
Sore throat


Airway compromise
Stridor
Drooling
Inadequate breathing
Shock
Unresponsive child
RED
Altered conscious level
Known or likely immunosuppression
Special risk of infection Hot baby
Very hot Severe pain
ORANGE
Rapid onset
History of recent foreign travel
Hot
Moderate pain
RISK LIMIT
YELLOW
Warm
GREEN

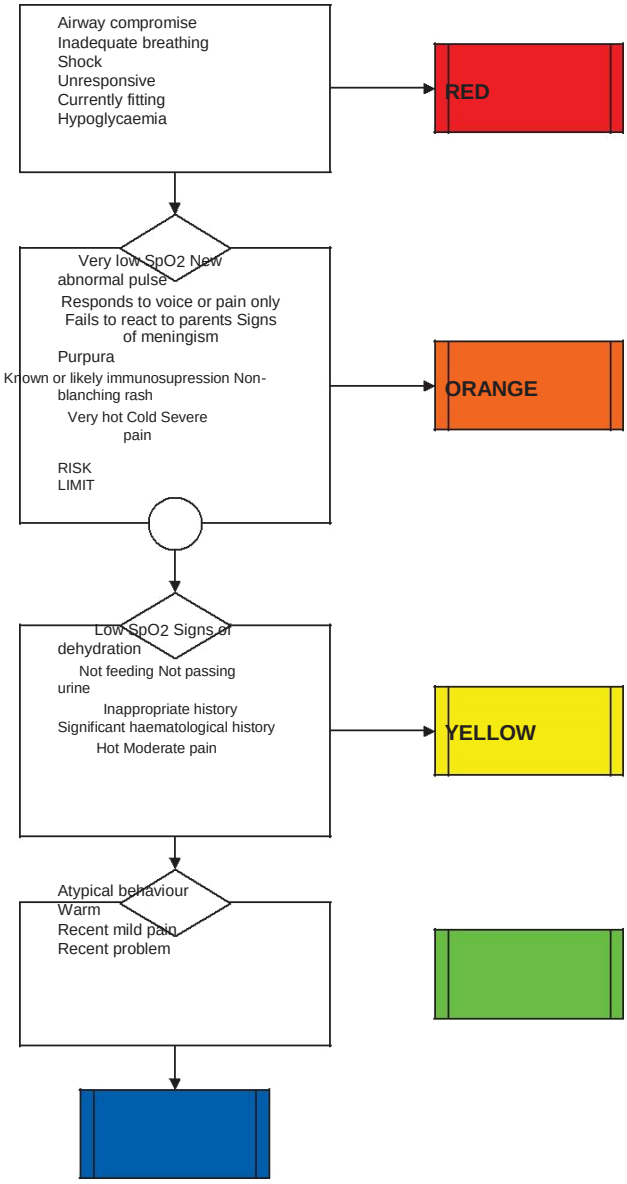
Testicular pain



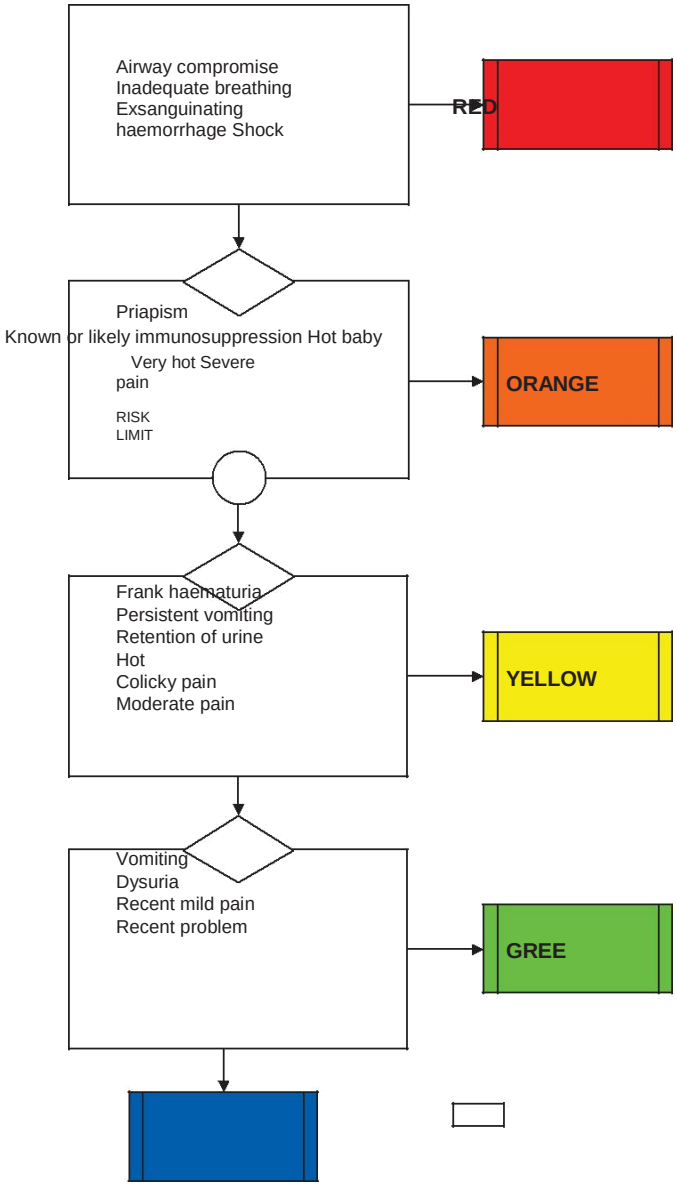
Unwell baby (up to 12 months)



Unwell child



Urinary problems



13.8 LOCAL TRIAGE SCALE

Recommended Vital signs used by Local triage scale.

	NEWBORN 0-3 MONTHS	BABY 3-11 MONTHS	BABY 1-2 YEARS	CHILD 2-3 YEARS	CHILD 4-5 YEARS	CHILD 6-12 YEARS	CHILD 13-18 YEARS	ADULT 18+ YEARS
RESPIRATORY RATE/MINUTE	30-60	30-60	24-40	24-40	22-34	18-30	12-20	12-20
HEART RATE BEATS/MINUTE	100-160	100-160	90-150	80-150	80-140	70-120	60-100	60-100
MINIMUM SYSTOLIC BP mmHg	40	60	70	72	78	82	96	100
TEMPERATURE DEGREES CELCIUS	36-37.9	36-37.9	36-37.9	36-37.9	36-37.9	36-37.9	36-37.9	36-37.9
OXYGEN SATURATION %	95-100	95-100	95-100	95-100	95-100	95-100	95-100	95-100