

THE APPLICATION RELIABILITY OF THE SOUTH AFRICAN TRIAGE SCORE IN ADULT EMERGENCY CASES PRESENTING TO A CENTRAL ACADEMIC HOSPITAL.

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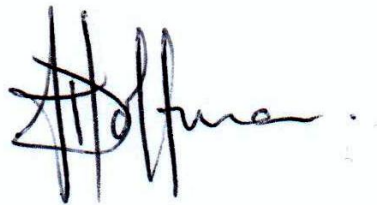
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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Medicine (MMed) in the Division of Emergency Medicine.

Johannesburg, 2014

DECLARATION

I, Deidré Ann Hoffman (Student Number 0715446F), declare that this research report is my own work. It is being submitted for the degree of Master of Medicine (Emergency Medicine) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

A handwritten signature in black ink, appearing to read 'Hoffman', with a stylized initial 'D' and 'A'.

Dr Deidré Ann Hoffman

On this 17th day of May 2014.

DEDICATION

To Matthiam

My constant, my closest, my love

ABSTRACT

Introduction: Over-triage and access-block are worldwide phenomena which critically compromise patient care and increase morbidity and mortality. Triage is designed to place the patient in the right place at the right time with the right resources. We sought to determine and evaluate the application reliability of the South African Triage Score/Scale (SATS) in adult emergency cases presenting to a central academic hospital and to identify which factors may have influenced this.

Methods: Emergency department (ED) triage data for adult patients at a central academic hospital in Johannesburg over a seven day period were captured retrospectively. The investigator applied the SATS ©2008 to each triage form. Triage scores and colour banding for the trier versus the investigator were compared and the overall degree of triage concordance and discordance observed.

Results: A total sample size of 1758 cases was recorded. Moderate agreement (quadratically weighted κ 0.524 at 95%CI 0.450-0.598) for the overall triage banding assignment revealed rates of concordance of 50.6%, discordance of 49.4%, over-triage of 28.5% and under-triage of 20.9%. Tuesday showed the highest patient load with 21.3% of the weekly total. The mean daily and hourly patient loads were 285 and 14 respectively. Time of day analysis showed a daytime predominance of 2/3 of total presentations and a peak hour between 08h00-09h00.

Conclusions: The over-triage (28.5%) rate fell within the American College of Surgeons Committee on Trauma's (ACSCOT) accepted rate of 30-50%, while under-triage (20.9%) exceeded the accepted ACSCOT levels (<10%). When the triage score was calculated and recorded there was improved concordance, inter-rater reliability and reduced over-triage. The discordance levels of over-triage decreased and under-triage increased respectively with increasing patient acuity. There was no significant correlation between the extent of triage concordance or discordance and patient load.

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NOMENCLATURE

Abbreviations

%	Percentage
ACEM	Australasian College for Emergency Medicine
ACEP	American College of Emergency Physicians
ACSCOT	the American College of Surgeons Committee on Trauma
ADAPT	Adaptive Process Triage
AIDS	Acquired immunodeficiency syndrome
ATS	Australasian Triage Scale
BP	Blood Pressure
CAEP	Canadian Association of Emergency Physicians
CHBAH	Chris Hani Baragwanath Academic Hospital
CI	Confidence Interval
CT	Computerised Tomography
CTAS	Canadian Triage and Acuity Scale
CTG	Cape Triage Group
CTS	Cape Triage Score
EC	Emergency Care
ECG	Electrocardiogram
ED	Emergency Department
EIP	Emergency Inpatient(s)
EM	Emergency Medicine
EMS	Emergency Medical Services

EMSSA	Emergency Medicine Society of South Africa
ENAs	Enrolled Nursing Assistants
ENA	Emergency Nursing Association
EP	Emergency Physician
ESI	Emergency Severity Index
G	Green triage colour banding (category)
GETS	Geneva Emergency Triage Scale
HC	Health Care
HCP	Health care professional/provider
HGT	Point-of-care Random Glucose measurement
HIV	Human immunodeficiency virus infection
HR	Heart Rate
HREC	the Human Research Ethics Committee
ICU	Intensive care unit
INV	Investigator
INV_BAND	Investigator triage banding calculated
INV_TSCORE	Investigator triage score calculated
IOM	Institute of Medicine
LOS	Length of stay
LWBS	Leaving/Left without being seen
MASH	Mobile Army Surgical Hospitals
MCI	Mass Casualty Incident
METTS	Medical Emergency Triage and Treatment System
MRI	Magnetic Resonance Imaging

MTS	Manchester Triage Scale
O	Orange triage colour banding (category)
PHC	Primary Health Care
PN	Professional Nurse
R	Red triage colour banding (category)
RR	Respiratory Rate
RSA	Republic of South Africa
SA	South Africa
SATG	South African Triage Group
SATS	South African Triage Score/ Scale
SD	Standard Deviation
SN	Staff Nurse
SpO₂	Percentage Oxygen Saturation
SRTS	Soterion Rapid Triage System
TATTT	Toowoomba Adult Triage Trauma Tool
Temp	Temperature
TEWS	Triage Early Warning Score
TR	Trieur
TR_BAND	Trieur triage banding documented
TR_TSCORE	Trieur triage score documented
TSS	Taiwan Triage Scale
Wits	University of the Witwatersrand
Y	Yellow triage colour banding (category)

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Chapter 1 INTRODUCTION AND LITERATURE REVIEW

1.1 Emergency Department crowding – the problem

1.1.1 Global significance and impact

Emergency Department (ED) overcrowding is a common scenario and growing global catastrophe that has reached crisis proportions and is well described in health care (HC) literature ¹⁻⁵. Widespread international concern exists regarding the continued escalation in the utilization, patient numbers or volumes and case severity/acuity in EDs amid on-going staffing shortages and resource constraints ^{4;6-8}.

EDs the world over (developed and developing countries alike) encounter soaring patient numbers which far exceed their capabilities resulting in critical delays and overcrowding ⁹⁻¹¹.

Overcrowding is a grave dilemma and an ongoing daily challenge which presents obstacles to delivering appropriate care in EDs across the world, and may compromise patient care ¹¹⁻¹³.

ED overcrowding has been described by Trzeciak *et al* (2003) as being the biggest threat to the viability of Emergency Care (EC) systems and departments ⁴.

EDs are increasingly being used as the route for initial access to HC systems worldwide and have subsequently emerged as the gatekeepers to acute and emergent care ¹⁴⁻¹⁶. Furthermore, EDs function as an essential safety net, by providing immediate patient care for unexpected illness or injury, in current HC systems which are stretched to the breaking point by overcrowding ^{9;17;18}.

It is well recognised that ED conditions, particularly overcrowding, are characteristic of HC system dysfunction and failure ^{4;19;20}.

1.1.2 Definition(s)

From the literature, when EDs become overloaded, two terms are most frequently applied, *crowding* and *overcrowding*. Both terms are used, apparently interchangeably, by investigators ^{22;23}. Though crowding is considered the more descriptive term by some, overcrowding is in common use and has been selected for this report ¹⁹.

The definition of **crowding** has developed over time. It has been summarised by the ACEP as a subsequent reduction in the quality of patient care which transpires in the ED, hospital, or both when inadequate resources exist to meet the need for emergency services ^{12;18;19;23}.

This implies that crowding can be quantified as a relationship between two variables: availability (resources) and demand for care, and arises when an imbalance occurs whereby supply is insufficient to meet demand ^{8;23}.

The above-mentioned ACEP's definition is adopted and described as **overcrowding** by the Australasian College for Emergency Medicine (ACEM) who add that ED function is impeded primarily due to the said discrepancy of patient numbers and needs versus the capacity and resources of the ED ^{1;19;24}.

The Canadian Association of Emergency Physicians (CAEP) and the National Emergency Nurses Affiliation further elaborated that the aforesaid imbalance of ED overcrowding hampers the ability to provide care within a reasonable length of time ^{5;22}.

ED overcrowding signifies an extreme excess of patient volume beyond the ED's treatment area capacity, thus compelling the ED to function beyond its capability to the point of dysfunction with a subsequent reduction in the quality of patient care^{4;19;23;25}.

1.1.3 Causes

Numerous studies agree that a myriad of multiple compound and multifactorial causes, as well as a complex interaction of internal and external factors, are the main culprits consistently shown to contribute to the growing crisis of ED overcrowding^{4;6;8;12;13;20;23;25;26}.

The combination of these factors largely fall into three categories: patient, departmental and hospital, or community factors²⁶.

Asplin *et al* (2003) (cited by Han *et al* 2010) further conceptualised three interdependent variables of ED overcrowding: **input, throughput and output**^{13;27}.

Input reflects on the origins, extent, types of ED care sought, aspects of patient inflow, and factors influencing the ED's ability to cope with the aforementioned demand for care and inflow^{18;22;23}.

Throughput refers to ED processes of care, bottlenecks within the ED, and factors associated with ED capacity, load and efficiency^{18;22;23}.

Output implies the transfer of patients out of the ED, bottlenecks outside the ED which impact on the ED, and factors affecting other areas within the HC system's capacity to provide timely care after ED discharge^{18;22;23}.

This conceptual model can be further sub-divided into the following factors:

1. INPUT ^{6;9;12;18;19;28;29}

- *Increasing ED patient volume*

EDs operate on a fulltime basis in order to provide emergency medical care, fulfil service demands and meet the public's expectations ^{9;30}.

- *Increased complexity and acuity of ED patients*

An ever growing demand for ED services exists largely resulting from an expanding ageing population with a high prevalence of complex medical conditions, improved diagnostic and therapeutic interventions, and improved survival in severe conditions ^{4;19}.

Subsequently there is a marked increase in ED presentations of more severely ill patients with higher levels of acuity which is a significant determinant of ED overcrowding ^{4;12}.

- *Non-urgent visits and inappropriate use of the ED*

Widely divergent opinions, discrepancy and lack of consensus persists regarding the definition of non-urgent ED visits, unnecessary use or misuse of the ED, and the nature of appropriate ED use ^{1;4;17}.

Non-urgent ED visits has been described by Durand *et al* (2011) as the category of patients whom a general practitioner could effectively treat ⁶.

Studies demonstrate that approximately fifty percent of ED patients present with non-acute complaints which was previously cited by many as one of the common causes of overcrowding ^{1;6;26;31}.

This concept has been debunked with no concrete proof that ED overcrowding originates from inappropriate ED visits ^{4;19}. Furthermore, it has been reported that the total number of ED presentations has a poor association with internal (treatment area) ED overcrowding and that non-urgent visits do not influence the fundamental ED function(s) ^{4;19}.

Thus, an increase in inappropriate ED visits results in waiting room crowding, rather than ED overcrowding ^{4;17}. This may occasionally impact on some aspects of ED service delivery and potentially compromise quality of care as ED staff attention is shared by non-urgent patients and high acuity patients demanding urgent management ³².

In 1971 Julius Roth (cited in Asplin 2001) identified crucial advantages to primarily attending the ED: reliability of access, efficiency of diagnostic services and availability of specialists and stated that “perhaps we should stop asking why people come to an emergency department and instead ask why anyone gets his care anywhere else” ¹⁷.

- *Expectations and sense of entitlement of patients*

This is a double-edged sword since access to EC is a constitutional right in most countries ⁸¹. However, and unfortunately so, there is a skewed sense of entitlement of patients to access hospital care for any and all ailments ³².

The South African Minister of Health, Dr Aaron Motsoaledi, recently expressed concern that the current trend of presenting to hospital EDs in preference to Primary Health Care (PHC) facilities has become a norm that is crippling South Africa's (SA) HC system, emphasising that a HC hierarchy exists which should be respected and observed ³².

- *Reduced access and inaccessibility to health care*

It has been shown that one to two thirds of patients presenting to EDs have low acuity complaints that could be dealt with appropriately at PHC facilities ³².

Some of the reasons cited for these inappropriate ED visits include inadequate or untimely access to PHC, convenience, lack of awareness regarding available PHC resources, and an inability to afford private HC ^{18;26}.

- *Frequent-flyer patients*

Frequent callers are defined by 4 or more annual visits and account for approximately ten percent of total ED visits ¹⁸.

- *Seasonal influx (influenza season)*

During the winter months for example, with the increased incidence in influenza and influenza related illnesses, there is an upsurge in ED visits and increased inflow occurs.

2. THROUGHPUT ^{5;6;9;12;18;22;28;29}

- *ED Nursing staff shortages*

The backbone of care in EDs is delivered by nursing personnel ²⁸. Thus nursing staff shortages in the ED is one of the factors recognised and linked to increasing waiting times, ED overcrowding and inadequate nurse-to-patient ratios ^{6;12;18;25;29;33}.

- *ED Physician staff shortages*

Similarly, several studies have also identified ED physician staff shortages as a common factor affecting throughput, overcrowding and predisposing patients to prolonged time to care ^{18;22}.

- *Lack of physical ED space and ED design*

The ED design, physical ED space and number of ED beds become significant limitations when ED patient volume increases ^{22;28}. Throughput decreases since ideally a bigger, better ED is required to facilitate and treat this larger number of patients ²⁸.

- *Ineffective ED triage process and interventions*

One of the factors recognised and linked to increase waiting times and ED overcrowding is **delayed triage**, which has been described by Finamore *et al* (2009) as the inability to effectively triage great numbers of patients presenting to EDs ⁵.

- *Radiology, laboratory and ancillary services*

In the realm of Emergency Medicine (EM) prompt access to special investigations is imperative ²⁴. These diagnostic services include: radiology (plain X-rays, CT scans, MRI scans), laboratory investigations and electrocardiographs (ECG). These are vital services and determine ED patient management, diagnostic and treatment protocols, and patient disposal and discharge. Where the above-mentioned services are lacking, inefficient or time-consuming to access a predisposition to ED overcrowding occurs ²⁸.

Moreover an increased utilisation of resources, with a high number of requests for screening and advanced imaging investigations, is linked to longer ED length of stay (LOS) ³⁴.

- *Avoiding inpatient admission by intensive therapy in ED*

With advances in medicine, improved practice standards and the growth of EM as a speciality there are numerous patients who are treated, observed and often discharged from the ED who previously required admission ²⁸.

Since advanced care is provided for longer periods, more ED resources are utilised ²⁸. Whilst throughput may be impaired, the possibility of output issues is reduced.

- *Increased medical record keeping and documentation requirements*

ED throughput is delayed by the ever increasing bulk of patient documentation, request forms, consent forms, prescriptions and medicolegal record keeping required ⁹.

- *Unavailability or a delayed response time to ED consultation*

Emergency physicians (EP) require numerous consultations from other medical disciplines, teams and specialties to attend and review ED patients daily. Any delay in response time to such ED consultations results in diminished throughput^{9;22}.

- *Administrative, clerical and support staff shortages*

A multitude of administrative and support activities are central to efficient patient flow and optimal ED functioning. For example: telecommunications, paperwork (files), stock orders, patient registration for admission, cleaning services, in-hospital patient transport (porter), security, ECG technician services and phlebotomy, to name a few²⁸.

3. OUTPUT^{6;12;18;22;28;29}

- *Boarding and Access Block*

Boarding is described as the number of admitted patients housed in the ED for an extended period awaiting hospital admission^{22;24}. This is due to a lack of appropriate inpatient bed availability, capacity and flexibility^{19;24}. Boarding refers to the percentage of emergency inpatients (EIP) or boarders²².

The failure of patients to gain appropriate inpatient access to HC facility beds within a reasonable timespan (no greater than eight hours) has been defined as **access block** by the ACEM²⁴.

Access block is also expressed as the proportion of patients ‘being boarded’, pending transfer elsewhere, or who demise in the ED who have exceeded the eight hours boarding time (triage arrival to ED discharge) in the ED ^{18;19}.

According to Hoot *et al* (2008) patient boarding and consequent access block is a common epidemic ¹⁸. With as many as one quarter of all ED patients boarding, it is regarded as one of the most significant causes of ED overcrowding which compromises ED functionality, efficiency and patient safety as a result ^{12;18;22;24;33;35;36}.

Access block poses the greatest threat to quality EC with a diminished capacity to attend to new ED patients, an added risk of medical errors, a delay in time critical medical management, the consumption of precious and often limited ED resources and a resultant rise in morbidity and mortality ^{24;33;35;36}.

- *Inadequate and inefficient inpatient bed facilities*

ED boarding and access block is often coupled with inadequate inpatient bed capacity and inefficient bed management ^{4;24;35}. The subsequent inability to transfer ED patients to an appropriate inpatient bed in a timely fashion creates gridlock ^{19;24;25;36}.

However, a lack of inpatient capacity is not the sole determinant of ED boarding and an increase in capacity alone will have minimal impact in isolation without parallel patient flow management ³⁵.

- *Difficulty in arranging follow-up care*

After appropriate focused examinations and investigations some ED patients are discharged with further outpatient follow-up requirements. Difficulty in organising appropriate follow-up care may result in avoidable, nonessential patient admissions and additional investigations to avoid losing the patient in the system ²⁸.

1.1.4 Effects

The numerous negative outcomes of ED overcrowding are well-defined and the consequence is not merely inconvenient ^{1;37;38}. It can compromise the quality of EC ³⁸.

The many effects of overcrowding include:

1. Compromised quality care and suboptimal clinical outcomes

The very core of EM and mission of the ED is threatened by the adverse effects of ED overcrowding on the quality of patient care, poor clinical outcomes and a reduction in patient safety ^{1;2;4;13;19;20;25;27;37}.

- *Medical errors*

It has been aptly stated by DelliFraine *et al* (2010) that the complexity and quantity of ED activities predisposes the discipline of EM to medical errors

¹⁵.

Thus, whilst not the single culprit, ED overcrowding is indeed an exacerbating factor and has been recognised as an impending high risk environment predisposed to medical errors ^{4;19;21;25}.

- *Treatment delays*

ED overcrowding is widely blamed as a significant contributing factor to delays in the prompt evaluation, recognition, management and timely treatment of acutely ill patients, time sensitive disorders and the subsequent increase in morbidity and mortality ^{4;8;11;13;19-21;23;25;39}.

Most authors concede that increased waiting and boarding times triggers a hotspot of high acuity patients in the ED which exceeds the ED's capacity ⁴. The investigator concurs. However, many have recently challenged the above-mentioned customary idea, maintaining that the treatment phase (time) of care is driven by the patient's clinical features and is insignificantly affected by boarding ³⁴.

- *Staff desensitisation*

Desensitisation of triage nurses to patient acuity levels, following ED overcrowding, has been suggested ³⁹.

- *Decreased ability to respond to disaster situations*

Overcrowded EDs are overwhelmed and become stunned. This compromises the ED capability and leaves the ED unprepared and unable to respond to or accommodate mass casualty emergencies ^{4;8;25}.

- *Morbidity and Mortality*

Cohen (2013) frankly states that “crowding causes deaths” ²¹.

In addition to the above-mentioned effects and their increased risk of disability or death, long waiting times may also prolong pain and suffering due to infrequent and inadequate analgesia ^{9;19;23;38}.

Moreover, increasing patient frustration levels, complaints and legal actions, and dissatisfaction with ED care have been noted ^{9;11;13;19;23;27;29;34}.

2. Further Patient impact

- *Increased waiting times* ^{23;37}

Waiting time has been described as the time interval from first arriving at the ED until being seen by the HC clinician ⁴⁰.

Waiting times may be significantly prolonged due to ED overcrowding, which may further result in some patients ‘leaving without being seen’ (LWBS) ^{25;27}.

- *Increased length of stay (LOS)*

ED LOS can be described as the time a patient spends in the ED ³⁴.

As the incidence and burden of ED overcrowding increases, longer ED patient waiting times and ED LOS occurs ^{21;29}. This in turn results in even higher levels of ED overcrowding and further amplifies and intensifies all the associated negative effects ^{6;29;34}.

One can extrapolate then that all the *causes* of ED overcrowding are causes of increased ED LOS, an *effect* of ED overcrowding. ED LOS in turn worsens ED overcrowding and perpetuates the vicious cycle ¹⁹.

- *Increased 'leaving without being seen' (LWBS)*

Bambi *et al* (2011) defines **left without being seen** (LWBS) as those patients who self-discharge prior to being seen by the EPs ⁴¹. He further added that the proportion and frequency of LWBS varies and correlates well with ED overcrowding ⁴¹.

Numerous risk factors and reasons for LWBS exist in the literature, ED overcrowding and boarding being the greatest ^{13;21;41}.

It has been demonstrated that the percentage of LWBS is inversely proportionate to patients' ED triage acuity level ⁴¹. Paradoxically and of major concern is the reported high prevalence, up to thirty five percent according to Ortega *et al* (2000) (cited by Bambi *et al* 2011), of 'worsening patient condition' as the reason for LWBS ⁴¹.

- *Reduced patient privacy and dignity*

Patient privacy, confidentiality, dignity and comfort are compromised as ED overcrowding occurs, boarding worsens and the noise and frustration levels rise ^{3;23;33}.

3. Emergency Medical Services (EMS) diversions^{18;21}

Ambulance diversion or bypass is defined as the scenario when access block (overcrowding) at a HC facility prohibits the emergency medical services (EMS) ambulances from distributing patients to the nearest hospital²⁴.

ED boarding and access block has additional effect on the prehospital EMS and is independently associated with the incidence and frequency of EMS diversion^{18;42}. Wiler *et al* (2012) suggest that both boarding and access block serve as proxy for deficient ED function and flow²⁹.

Ambulance diversion potentially jeopardises new patients³⁸. They are subject to longer EMS transport time to the next appropriate HC facility and thus have delayed EC^{4;38}.

4. ED Staff

ED overcrowding, increased LOS and subsequent elevated stress on ED staff impact negatively on staff satisfaction, frustration and morale the ramifications of which are reduced staff productivity, rising burnout and high ED staff turnover^{3;4;13;19;23;34;37}.

5. Increased cost of care

Both increased ED overcrowding and boarding results in an increased consumption of HC resources and a resultant increase in the cost of care.

6. Miscommunication and violence

As with medical errors the harsh overcrowded ED environment lends itself to social errors including ineffective communication on all levels (doctor-to-patient; doctor-to-doctor; doctor-to-nurse), inadequate doctor-to-patient relationship and general frustration, often culminating in violence in the ED ¹.

Violence is defined by the National Occupational Health and Safety Commission of Australia (NOHSC 1999) as “the attempted or actual exercise by a person of any force so as to cause injury to a worker, including any threatening statement or behaviour which gives a worker reasonable cause to believe he or she is at risk” ⁴³.

Violence is a common occupational hazard faced by health care providers (HCP) worldwide and EDs are deemed high risk areas ^{1;44}. The incidence of exposure to violence ranges from sixty to ninety percent. This worsens ED working conditions, staff morale and decision-making abilities ^{1;43}.

1.1.5 Future course and trend

Consensus on the future direction of ED overcrowding is disconcerting:

- ❖ ED visits, overcrowding and access block will rise ^{24;30;33;42;45}
- ❖ Resources will remain limited ^{42;45}
- ❖ The impact on EM and HCPs is unavoidable ²⁰
- ❖ It is associated with poor patient care outcomes ^{13;19;20;24}

- ❖ The problem consists of a blend of patient-centred, hospital or system and clinical factors ^{24;26}
- ❖ No simple solution exists ²⁵
- ❖ It is imperative to focus and streamline systems to alleviate the causes and effects while maintaining quality of care ⁴²

Triage systems have been widely implemented and have evolved over time as *the* system to cope when demand exceeds supply by allocating patient priority levels for clinical justice and system efficiency purposes ^{1;46}. Studies have reported a decrease in some of the effects of overcrowding when advanced triage protocols are employed ³⁷.

However, the rising demand for limited resources, access block and ED overcrowding have placed the continued benefit and value of triage processes or systems under scrutiny ^{46;47}.

Further arguments around the operational, logistical and fundamental ethical concerns of triage versus overcrowding have emerged, the lesser of two evils debate, with suggestions to dispose of triage ^{23;46}.

The Investigator is yet undecided in the above-mentioned debate however since Triage, though not perfect, has shown some mitigation in the result of overcrowding on ED functioning and patient care one is inclined to observe the practice of Triage until a superior alternative is presented ³⁷.

1.2 Triage

1.2.1 Evolution of triage

Stemming from the necessities of military warfare, triage principles have markedly evolved from its purported origins in sorting coffee beans to its current role in medicine ^{48;49}.

Triage has developed over time, across several wars, and continues to have a strong link with military medicine ⁴⁸.

During the Napoleonic Wars (1792-1815) Chief French Surgeon, Baron Dominique-Jean Larrey devised the first formal classification system of ranking the wounded, battlefield triage ⁴⁸⁻⁵³. He adopted a new paradigm in the standard of care: those with the most severe, serious, life-threatening injuries would receive first treatment priority, irrespective of rank, privilege, nationality or regard for survival ^{48;51;52;54}.

In 1846 British naval surgeon John Wilson made the next huge contribution by describing the principles of Mass Casualty Incident (MCI) triage ^{48;55}. He deferred care for both the minor and probable fatal (hopelessly injured) and assigned immediate treatment priority to the most salvageable patients in whom it was most likely to be successful and beneficial ^{48;53}.

Triage principles further evolved as triage processes were systematically refined across the US Civil War (1861-1865) and World War I (1914-1918) where minimally wounded were prioritised and soldiers returned to combat was maximised ^{48;49;53;56}. World War II (1939-1945) saw significant advances in protocols and improved battlefield survival ^{48;49}.

During the Korean War (1950-1953) and the Vietnam War (1955-1975) triage advancement and the dogma of *doing the greatest good for the greatest number*, the advent of MASH (mobile army surgical hospitals) and the development of aeromedical transport and evacuation further increased survival ^{48;49;52;53}.

The transition from Military Triage to the introduction of Civilian Triage as a fundamental component of modern clinical practice and EDs worldwide followed ^{51;56}.

Triage has come a long way from what Mitchell (2008) described as *doing our best in a bad situation* while the lasting effects of Larrey's ground-breaking ideas will continue to have a far-reaching and positive impact ^{49;54}.

1.2.2 Triage Definitions

Triage is derived from the French verb *trier*, meaning to sort, separate, sift or select ^{1;48;49;54;57-59}.

The **Trieur** is the person who performs triage, often referred to as the triage officer ⁴⁶.

The **triage process** is that which analyses patient need and acuity, categorises patients accordingly, and assigns a treatment priority ⁶⁰. The appropriate level of care and timeous intervention occurs according to the patient's level of acuity whereby the viable critically ill patients are primarily treated followed by less urgent, lower resource-dependent patients ^{10;51}.

Augustyn (2011) describes triage as “... putting the patient in the right place at the right time to receive the right level of care ... and the allocation of appropriate resources to meet the patient’s medical needs” ^{59;61}.

Emergency medical treatment arises when a person is faced with the real possibility of death, serious bodily injury or deterioration in health and is defined by the SA Constitutional Court as ‘a dramatic, sudden (acute) situation or event which is of passing nature in terms of time’ that is treatable and curable through medical treatment ⁸⁰.

Acuity describes the extent to which a medical condition is life- or limb-threatening and the urgency of effective management required to alleviate the condition ^{63;64}.

1.2.3 General background – triage environment

One of the unfortunate core elements of EM, EDs and triage is that it is often mandatory to apportion inadequate, limited resources (supply) to limitless medical requirements (demand) ⁴⁶. Subsequently immediate access to particular individualised HC is not possible for all ¹.

Triage applies to particular environments where the medical capacity is exceeded by the severity and number of casualties or when an unlimited medical need considerably outstrips a limited resource ^{46;48;65}.

The importance of attending to patients in accordance with need, regardless of the sequence of arrival, is highlighted by Forsgren *et al* (2009) ⁶⁰. Triage has evolved the provision of EC from the outdated customary tenet of *first come, first served* to the current best practice of tailored EC - *how come, how served* ⁴⁸.

Triage is thus a valuable tool in facilitating decision making, expediting time sensitive management, rationing the allocation of scant medical resources and delivering appropriate care when numerous patients concurrently require a variety of medical treatment ^{1;48;49;66;67}.

Funderburke (2008) adds that “the triage system acts as a means of communication” and has become increasingly valuable in the above-mentioned setting of ED overcrowding and limited resources ⁵⁸.

It is believed that the use of triage requires that 3 conditions be satisfied: ^{1;48}

1. At least a modest scarcity of health care resources exists.
2. A HCP (triage officer or Trier) assesses each patient’s medical needs, usually based on a brief examination.
3. The Trier uses an established system, usually based on algorithm or set of criteria, to determine the specific treatment and treatment priority for each patient.

Katoch *et al* (2010) mentions that triage endeavours to render initially overwhelming and chaotic circumstances manageable by imposing order ⁵².

1.3 Emergency Department Triage

Numerous categories of triage exist. The most familiar include ED triage, inpatient (ICU) triage, incident (multicasualty) triage, military (battlefield) triage, and disaster (MCI) triage ⁴⁸.

The first exchange between the patient and the HC system occurs at 'Triage' ¹.

The ED is thus a critical point of contact and emergency HCPs are considered the 'first receivers' and 'gatekeepers' of the hospital ^{14;68;69}.

Internationally, triage is the sorting system of choice ⁷⁰. It is considered an essential function of EC and a pivotal component in the effective management, quality and safety of modern EDs ^{1;46;63;71-73}.

Emergency Department (ED) triage refers to the process of rapidly sorting patients shortly after arrival by accurately assessing patients severity of illness or injury, allocating priorities and assigning the correct patients to the necessary resources at the appropriate time before their clinical condition deteriorates ^{16;64;74}.

One of the core priorities in reducing morbidity and mortality and optimising outcomes in all patients presenting to an ED is providing appropriate patient care and treatment within the shortest time possible ^{46;59;75}. Thus, decreasing the waiting period for critically ill patients and establishing 'who will not be disadvantaged by longer waiting times' is the key purpose for introducing triage systems worldwide ^{46;75;76}.

1.4 Triage performance

It has been well published that the performance of a triage tool is evaluated by assessing and determining reliability and validity ^{59;64;89;91}.

Reliability is described as the internal consistency and equivalence with which an attribute is measured and refers to the extent of standardisation in the repeated application of the tool ^{59;91}. The aforementioned is referred to as the **application reliability** for the purposes of this study.

Reliability can be further expressed as the degree of variability or agreement within a particular observer (intra-rater), and between different observers (inter-rater), using the same triage tool ^{64;91}.

Twomey *et al* (2012) clearly states that “triage tools should be highly reliable” yet the most apt method of measurement for reliability remains undecided ⁹¹.

Validity is defined by Polit *et al* (as cited by Augustyn *et al* 2009) as “the degree to which an instrument measures what it is supposed to measure” ⁵⁹. Validity thus requires an objective external reference (absolute gold standard) in order to assess the accuracy of the triage tool to identify the true patient acuity level ^{64;91}.

1.5 Triage Internationally

Several ED triage systems exist internationally, designed and developed with the intention to assess severity, accurately stratify patients, identify the degree of urgency and treatment priority and estimate predicted resource utilisation by using objective data to assess patient acuity ^{10;47;77}.

The assortment, diversity and variance of triage models in use support the commentary by Augustyn (2011) and FitzGerald *et al* (2010) that there is no ‘absolute magic bullet’ (triage system) or approach suitable to every HC system or context ^{46;61}.

Triage systems have progressed over the years from two-level, three-level and four-level systems to the current five-level triage systems. Five-level systems are proven to be more accurate, effective, valid, reliable and superior in determining patient acuity and resource utilisation ^{1;70;78}. They also have a higher level of inter- and intra-rater reliability ⁶⁸.

Hence there is an international commitment to five-level triage systems and is considered the universal gold standard in EM ^{16;46}.

The most common, best studied and most widely distributed five-level systems which have had the greatest influence on modern ED triage include the Canadian Triage and Acuity Scale (CTAS), the Australasian Triage Scale (ATS), the Manchester Triage Scale (MTS) and the Emergency Severity Index (ESI) ^{16;73;74}.

These scales are widely disseminated and implemented in numerous countries and individual institutions ^{46;73}. However there are also several other international triage instruments in use, though less common, which include the Medical Emergency Triage and Treatment System (METTS), the Adaptive Process Triage (ADAPT), the Gruppo Formazione Triage system, the Taiwan Triage Scale (TSS), the Geneva Emergency Triage Scale (GETS), the Soterion Rapid Triage System (SRTS) and the Toowoomba Adult Triage Trauma Tool (TATTT).

1.6 Triage in South Africa (SA)

1.6.1 The SA emergency care (EC) population and environment

SA represents a developing country and access to EC is a basic human right guaranteed in the Constitution of the Republic of South Africa (RSA) ^{79;80}. The Bill of Rights contained therein and the National Health Act states that “no one may be refused emergency medical treatment” ^{32;80-82}.

Substantial variations exist between the EC populations and environments in the developed and developing world ⁸³.

In South Africa, the EC population is characterised by delayed patient presentations, a greater proportion of high acuity and severity cases, ever increasing patient volumes (above ten percent annual increases) and overcrowding ^{7;57;64;82;84}. This results in prolonged ED waiting times ⁵⁷.

Rosedale *et al* (2011), Wallis *et al* (2008) and Maritz *et al* (2010) describe that EDs are at the forefront of South Africa's so-called 'quadruple burden of disease': Violence/Trauma injuries; HIV/AIDS; Infectious diseases; and Chronic diseases of lifestyle ^{57;82;84;85}. The SA trauma rate is amongst the highest worldwide, accounting for an estimated one third of admissions ^{57;82;85}.

All of the above-mentioned places the SA public sector ED environments under enormous pressure, a system already overstretched, plagued by underfunding, understaffing and inadequate resources ^{7;57;82;84}. This exacerbates the challenges and accentuates the demand for improved EC ^{7;57;82}.

1.6.2 History and Development

In light of the above, the international triage tools have limited applicability, value and relevance in developing countries due to their complexity, extensive training needs and lengthy patient triage (assessment) times. This renders them impractical and unsuitable for SA purposes where the EC population and environment mandates the use of a more rapid and unique system ^{7;46;65;86}.

Prior to the implementation of Cape Triage Score (CTS) no uniform, recognised or nationally accepted triage system existed in SA ^{61;86;87}. Traditional ad hoc triage and attending to patients on a first come, first served basis, though considered the norm, was recognised as being inadequate ^{86;87}.

As summarised by Wallis et al (2006) “the terms ‘stable’ and ‘unstable’ failed to reflect the patient’s clinical condition accurately” ⁸⁶.

This highlighted the vast gap in SA emergency care and the necessity to prioritise patient care, while the lack of an appropriate triage system to do so became obvious ^{84;86}. Dr Clive Balfour, former Chairman of the Emergency Medicine Society of SA (EMSSA) succinctly stated (as cited by Bateman 2006) that ‘we had to stop this circus’ ⁸⁷.

In 2004 the South African Triage Group (SATG), formerly the Cape Triage Group (CTG), was convened with the aim to produce a triage system tailored to South Africa’s specific needs for use in EDs across SA ^{45;86-88}.

The CTS became the first SA national triage system, implemented in the Western Cape on 01 January 2006 ^{59;86}.

1.6.3 The South African Triage Score/Scale (SATS)

The Cape Triage Score (CTS) was further adapted and expanded to the South African Triage Score/Scale (SATS) and introduced into EDs from 2007 ⁶¹.

As described by its champions, Wallis & Balfour (2007) “the SATS is a living tool, developed to fit local needs and shown to have a significant positive impact on patient care” ⁸⁹. It is safe and efficient, improves timing of patient care, ensures rational resource utilisation, prevents unnecessary deaths and provides a medico-legal benefit for both patients and HCPs ^{57;81;87}.

The SATS, a five-level triage system, is an initial age appropriate assessment of patient acuity and medical urgency priority. It consists of the Triage Early Warning Score (TEWS) and the Clinical Discriminator list and determines the patient's triage (acuity) level and target time to treatment ^{64;87;90}.

The TEWS incorporates and translates several physiological parameters, including a trauma factor, into a value ^{57;86}. It assists to successfully identify patient deterioration and promotes early medical intervention ^{61;86}. The TEWS was researched, adapted and designed for the SA emergency care context ^{57;61}.

The clinical discriminator list serves as a 'safety net' since TEWS will not correctly categorise a patient who does not display *abnormal enough* physiology ⁶¹.

The five triage banding colour categories include: ⁸⁵

- RED – immediate priority; emergency resuscitation
- ORANGE – very urgent priority; potentially life or limb-threatening
- YELLOW – urgent priority ; reasonably significant pathology
- GREEN – delayed priority; minor injury or illness
- BLUE – deceased (dead)

Due to the restricted number of ED doctors and professional nursing staff the SATS was intentionally designed for application by Enrolled Nursing Assistants (ENAs) ^{83;90;91}. The SATS is validated for use in the public, private and prehospital health care domains ⁸⁸. The reliable, valid and user-friendly SATS tool is currently utilised in six sub-Saharan countries ^{64;90}.

The SATS (© South African Triage Group 2008) was introduced at Chris Hani Baragwanath Academic Hospital (CHBAH) in December 2009. On the job training in the use of the SATS was provided by EM registrars, over a period of two months, for all ED nursing staff employed at the time. Subsequent triage training is undertaken by the senior ED nursing staff, under ED Nursing Management. The SATS is applied by ED Nursing Staff with varying levels of qualification, and continues to be used to date.

Following the introduction of the SATS, the ED nursing-centred triage process at CHBAH has not been formally assessed. Based on the global importance of triage and the large number of patients triaged at this sizeable facility the aim of this study was to analyse the application reliability of the SATS in the adult ED and its impacting factors.

Chapter 2 **AIMS AND OBJECTIVES**

2.1 Study aim

The aim of this study was to compare, evaluate and determine the application reliability of the adult South African Triage Score/Scale (SATS) at a central academic hospital and to identify any factors which may have influenced the application reliability.

2.2 Study objectives

1. To evaluate and review the SATS triage process for adult ED patients over a one week period at a central academic hospital.
2. To determine the application reliability of the SATS and compare the extent of agreement (reliability) between the investigator (INV) and the trieur (TR).
3. To identify and determine whether certain factors (recorded triage score, varying patient acuity levels, daily patient load numbers, number of patients per hour, day versus night and different nursing levels of qualification) had significant correlation with the application of the SATS or patterns of triage concordance and discordance.

Chapter 3 **MATERIALS AND METHODS**

3.1 Ethics

This research was approved by the Human Research Ethics Committee (HREC) of the Faculty of Health Sciences of the University of the Witwatersrand (Wits) (protocol approval number M111141, see Appendix A). Permission was obtained from the Chief Executive Officer, Medical Advisory Committee and Research Board from the participating hospital (see Appendix B). Permission was obtained from the Clinical Head of Department in the discipline of EM at the participating hospital. Informed consent was not required from any ED personnel (Trieurs) since the Investigator (INV) was blinded to the identity of individual Trieurs (TR). In the unlikely event that an Individual TR was identified as performing poor patient triage a Triage Refresher Training Course was facilitated and offered. Informed consent was not required from any patients since all data was collected retrospectively and no personal patient identifying information or data was captured or reviewed.

3.2 Study Design

A retrospective descriptive review.

3.3 Study Setting

The site of the study was Chris Hani Baragwanath Academic Hospital (CHBAH) Emergency Department (ED), Diepkloof, Johannesburg, South Africa.

CHBAH is one of the largest hospitals in the world with an approximate 3200 inpatient bed capacity. The ED patient visits account for approximately 12 000 cases per month.

The above-mentioned ED patients' presenting complaints or conditions mainly span across the disciplines of Internal Medicine, General Surgery, Trauma and Orthopaedics. The disciplines of Paediatrics and Obstetrics and Gynaecology have individual, independently functioning EDs and thus a very small proportion of such patients are occasionally attended to in the study ED.

3.4 Study Population and Sample

3.4.1 Sample size

The sample size was not specifically calculated. The larger local studies which are referenced and used for comparison of results (see Table 5-1) consist of sample sizes (n) greater than 1000 ^{85;90;97;98}.

3.4.2 Inclusion criteria

- All adult patients presenting to the CHBAH ED from 00h00 8 March 2011 – 23h59 14 March 2011 (a seven day week representing a 'normal' work week within the ED i.e. not including public holidays), for which the South African Triage Score/Scale (SATS) was applied and triage forms were completed.
- For the purposes of this study an 'adult' was defined as a person over the age of 16 years.

3.4.3 Exclusion criteria

- Triage forms with incomplete vital signs or discriminators documented, preventing the scoring and triage banding (colour coding) of patients, were noted but not included in the analysis, comparison and correlation of triage accuracy.

3.5 Measuring Tool

In keeping with CHBAH ED protocols, The SATS (© South African Triage Group 2008) (see Appendix C) was used by the TR to triage all presenting patients (sample population).

The same SATS ©2008 tool was applied, using the documented data from the CHBAH ED triage form(s) (see Appendix D), when calculating the INV triage score and banding.

The Adult SATS ©2008 version, consisting of a Triage Early Warning Score (TEWS) and a clinical discriminator list, was applied by the INV using the five (5) step process included in the CHBAH ED triage protocol (see Appendix C), as shown in Figure 3-1 below.

Retrospective implementation of the measuring tool by the INV precluded step 1 and step 2 from being performed. The INV only reviewed the de facto information (history and vital signs) recorded by the TR. Visual cues regarding patients' clinical appearance were also not observed by the INV. These are important methodological limitations of the study.

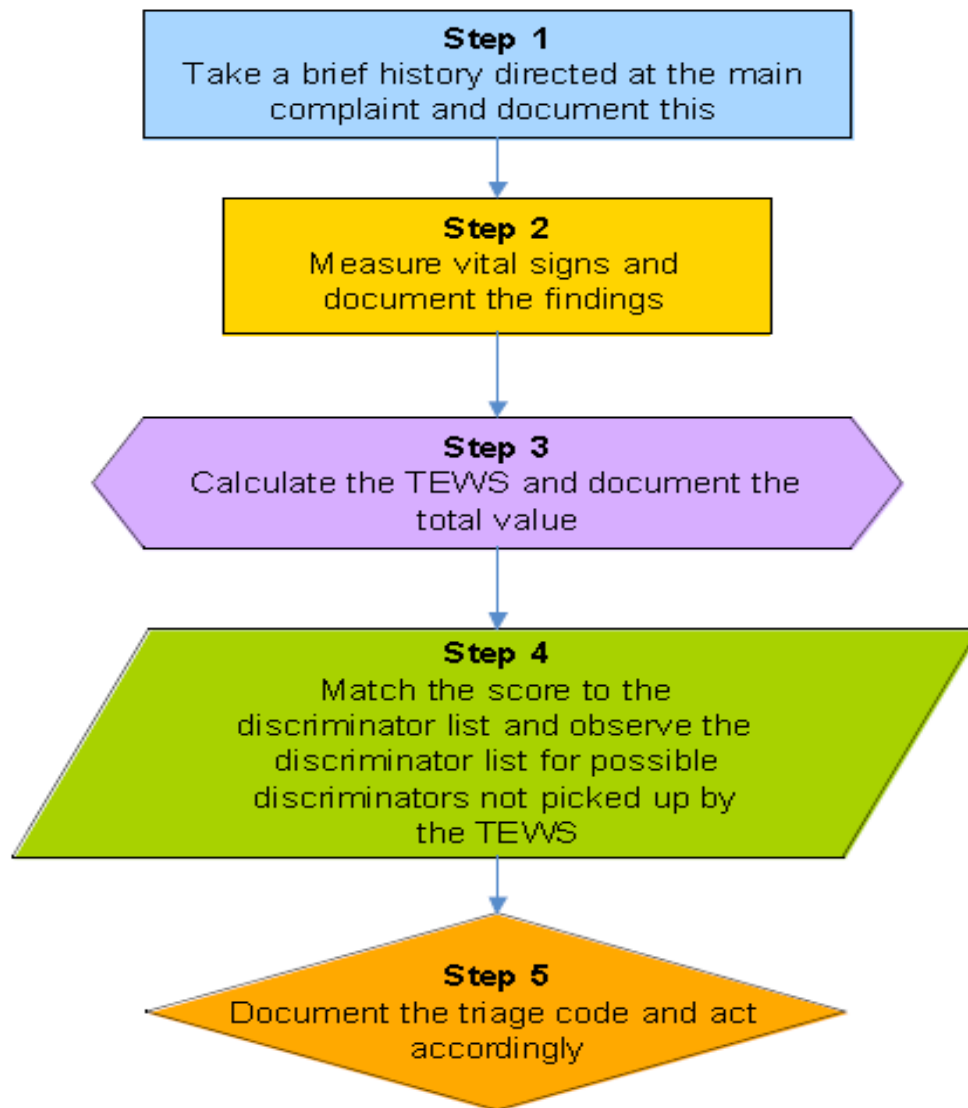


Figure 3-1: SATS ©2008 flowchart extracted from CHBAH ED triage protocol

Step 1

A concise history surrounding the patient's main complaint was obtained – including any history of trauma. A focused enquiry regarding possible, potential discriminators is performed.

For example: a patient presents to the ED complaining of severe chest pain, with no history of any trauma and walks in assisted by a relative.

Step 2

The patient's vital signs were clinically measured, these included: Respiratory Rate (RR), Systolic Blood Pressure (SBP), Oxygen Saturation (SpO2), Heart Rate (HR), Temperature (Temp) and HGT (point-of-care glucose reading).

Example: The patient has a RR 12, HR 107, SBP 90, Temp 36.2 °C, SpO2 97% and HGT 6.

Step 3

Calculation of the TEWS was then performed.

The patient's *mobility* status, four (RR, HR, SBP, Temp) of the above *vital signs*, an *AVPU* ('Alert, Verbal, Pain, Unresponsive') Scale for level of consciousness was done and any *trauma* history were transferred onto the TEWS.

As shown in Figure 3-2 below a corresponding cross ('x') was placed in one block per row.

	3	2	1	0	1	2	3
Mobility				Walking	With X Help	Stretcher/ Immobile	
RR		less than 9		X 9-14	15-20	21-29	more than 29
HR		less than 41	41-50	51-100	X 101-110	111-129	more than 129
SBP	less than 71	71-80	X 81-100	101-199		more than 199	
Temp		Cold OR Under 35		X 35-38.4		Hot OR Over 38.4	
AVPU		Confused		X Alert	Reacts to <u>V</u> oice	Reacts to <u>P</u> ain	<u>U</u> nresponsive
Trauma				X No	Yes		

Figure 3-2: Extract from SATS ©2008 - Adult Triage Early Warning Score (TEWS)

The seven columns across contain various options with heading 3; 2; 1; 0; 1; 2; 3 at the top. The total TEWS value was determined by addition of all the separate scores correlating with each cross ('x') documented.

Step 4

The TEWS score was matched to the discriminator list.

Example: the total TEWS value is 3 (see Figure 3-2 above). This corresponds to the colour YELLOW as shown in Figure 3-3 below.

Colour	RED	ORANGE	YELLOW	GREEN	BLUE
TEWS	7 or more	5-6	3-4 X	0-2	DEAD

Figure 3-3: Extract from SATS ©2008 - TEWS score application in discriminator list

The discriminator list must be reviewed before assigning the final triage banding (colour) category to the patient. If any discriminators were present the patient was placed in a higher triage category (banding) overriding that of the original TEWS

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The discriminator list consists of: combined TEWS values, target time to treat, mechanism of injury, signs and symptoms presentation list, pain classification, and provision for the “senior HCP’s discretion” modifier, to adjust a patient’s triage colour banding.

As a rule patients may only be up-triaged and never down-triaged ⁶¹.

Example: while the patient was assessed as YELLOW, chest pain is noted as a discriminator in the ORANGE group and this patient should be up-triaged to the ORANGE acuity level, as depicted in Figure 3-4 below.

Step 5

Based on the final triage acuity level appropriate action is taken in terms of patient management.

Example: the final ORANGE triage colour banding implies that the target time to treatment was < 10 minutes (see Figure 3-4 below).

In conclusion, the latest Adult SATS chart © 2012 by the South African Triage Group (see Appendix E) is noted but was not used in the study. This is noted as a potential limitation to this study.

Colour	RED	ORANGE	YELLOW	GREEN	BLUE
TEWS	7 or more	5-6	3-4	0-2	DEAD
Target time to treat	Immediate	X less than 10 mins	less than 60 mins	less than 240 mins	DEAD
Mechanism of injury		High energy transfer			
Presentation		Shortness of breath - acute		ALL OTHER PATIENTS	
		Coughing blood			
		X Chest pain			
		Haemorrhage - uncontrolled	Haemorrhage - controlled		
	Seizure - current	Seizure - postictal			
		Focal neurology - acute			
		Level of consciousness reduced			
		Psychosis / Aggression			
		Threatened limb			
		Dislocation - other joint	Dislocation - finger or toe		
	Fracture - compound	Fracture - closed			
	Burn - face / inhalation	Burn over 20%	Burn - other		
		Burn - electrical			
		Burn - circumferential			
		Burn - chemical			
		Poisoning / Overdose	Abdominal pain		
	Hypoglycaemia - glucose less than 3	Diabetic - glucose over 11 & ketonuria	Diabetic - glucose over 17 (no ketonuria)		
		Vomiting - fresh blood	Vomiting - persistent		
		Pregnancy & abdominal trauma or pain	Pregnancy & trauma		
			Pregnancy & PV bleed		
Pain		Severe	Moderate	Mild	
	Senior Healthcare Professional's Discretion				

Figure 3-4: Extract from SATS ©2008 - Adult discriminator list

3.6 Study Protocol

3.6.1 Data collection

All data was collected from archived CHBAH triage forms which were manually collected, with the aid of the CHBAH ED clerk, from the administrative storeroom.

The following steps were followed:

1. Recorded vital signs, discriminators and documented *Trieur* triage score (TR_TSCORE) and colour banding (TR_BAND) were captured from CHBAH ED patient triage forms (see Appendix D) and transferred to the data collection sheet (see Appendix F).
2. The INV then independently applied the SATS, using the recorded vital signs and discriminators from CHBAH ED patient triage forms and calculated the *Investigator* triage score (INV_TSCORE) and colour banding (INV_BAND) for each particular patient.
3. On the CHBAH ED triage form (see Appendix D) the *Trieur* may have documented his/her name and provided their signature. Thus a list (see Appendix G) of sample signatures with the correlating qualification level of all CHBAH ED Nursing Staff employed during 8-14 March 2011 was obtained by an externally blinded person, as recommended by the Human Research Ethics Committee (HREC).

4. The externally blinded person correlated TR signatures from the aforementioned list with those documented and recorded the level of TR qualification on the patient triage forms prior to the INV review of the Triage forms. In order to prevent any possible bias while allowing capture of the Triageur(s) level of qualification by the INV onto the data collection sheet (see Appendix F). As recommended by the Human Research Ethics Committee (HREC).
5. The externally blinded person was in possession of and privy to the qualification list/level of ED Nursing Staff members with matching signatures. The list was kept by the Supervisor.
6. Individual Triageur names were not captured or listed (see Appendix G). Once data was entered into the data collection sheet (see Appendix F) only the TR level of qualification and resultant concordance or discordance would appear simultaneously. The individual TR signatures were not reviewed or captured by the INV. Thus it seemed unlikely that an individual TR would be identified as performing consistently poor triage.

3.6.2 Research Questions

- ❖ What is the extent of agreement of triage (score and banding) between the Triageur (TR) and Investigator (INV)?
 - What were the overall levels of concordance and discordance?
 - What were the levels of over-triage (assigning a higher acuity than patient's perceived true acuity level) and under-triage (assigning a lower acuity than patient's perceived true acuity level)? ⁷⁴

- ❖ How does the accuracy of the triage (concordance, discordance, over-triage and under-triage) relate to:
 - Whether or not the triage score was recorded by the Trier?
 - Patient acuity levels (band)?
 - Daily patient loads over 24 hours?
 - Hourly patient loads?
 - 12-hourly patient loads: day versus night?
 - Different Trier levels of qualification?

3.6.3 Data Analysis

The excel data sheets for the different days of the study week were combined and the Date variable added.

The INV triage scores were cleaned by removing references to mechanism of injury (MOI) and where a range of triage scores was given (e.g. 3-4), the lowest score was retained.

For TR and INV separately, the triage scores were cross-tabulated against the banding to check for impossible banding assignments (i.e. band less than indicated by triage score alone).

To review the aforementioned research question the following indicator variables were created:

- Concordant banding indicator (1=concordant; 0=discordant)
- Discordance type (concordant/over-triage/under-triage)
 - Over-triage indicator (1=over-triage by TR by at least one level compared to INV; 0=otherwise)
 - Under-triage indicator (1=under-triage by TR by at least one level compared to INV; 0=otherwise)
- Triage Score
 - Triage score indicator (TR_TSCORE=Trieur triage score; INV_TSCORE=Investigator triage score)
 - TR_TSCORE and INV_TSCORE indicators were reviewed for number (frequency percentage) of 'not recorded', 0,1,2,3,4,5,6,7,8,9 and 10.
 - For inter-rater comparison the TR_TSCORE and INV_TSCORE indicators were reviewed and compared to several variables: triage banding, grouped frequencies, recorded, not recorded, concordant, discordant, over-triage and under-triage etc.

- Patient Acuity
 - Triage colour banding indicator (TR_BAND=Trieur triage banding; INV_BAND=Investigator triage banding)
 - TR_BAND and INV_BAND indicators were reviewed for number (frequency percentage) of 'not recorded', Red, Orange, Yellow and Green.
 - For inter-rater comparison the TR_BAND and INV_BAND indicators were reviewed and compared to several variables: triage score, grouped frequencies, recorded, not recorded, concordant, discordant, over-triage and under-triage etc.
- Trieur level of qualification
 - The Trieur level of qualification was reviewed for number (frequency percentage) of 'unknown', PN, SN and ENA.
- Day/night (1=day: 07h00-18h59; 0=night: 19h00-06h59)
 - This indicator was set to 'missing' for Thursday 10 March 00h00-06h59 and 07h00-18h59 since no data was available for Thursday 10 March 00h00-08h59 and scanty data for Thursday 10 March 09h00-18h59 – triage forms presumed missing.

The following patient load variables were calculated:

- Number of patients per day
- Number of patients per hour
- Number of patients per complete twelve-hour (day-night) period

Correlation coefficients were calculated for each of the above-mentioned patient load variables for discordant, over-triage and under-triage.

3.6.4 Methods of analysis

The Pearson's chi-squared (X^2) test was used at the 95% confidence level to assess for significant relationships between categorical variables. The strength of the associations was measured by Cramer's V test. The absolute value of this coefficient was interpreted using the scale of < 0.10 to ≥ 0.50 . For this study a value ≥ 0.30 (moderate association and up) was considered significant.

Cohen's kappa provides a chance-corrected measure of agreement (i.e. a metric which corrects for the inter-rates agreement which may occur purely by chance) ⁹².

$$\kappa = \frac{\sum_{j=1}^c (\pi_{jk} - \pi_{j.}\pi_{.k})}{1 - \sum_{j=1}^c \pi_{j.}\pi_{.k}}$$

Where ⁹²

- c = the number of categories
- π_{jk} is the joint probability that the first rate classifies the patient as category j and the second rater classifies the same patient as category k
- $\pi_{j.} = \sum_k \pi_{jk}$ and $\pi_{.k} = \sum_j \pi_{jk}$

The above equation is suitable for nominal (unordered) categories. For ordinal (ordered) responses, the quadratically weighted kappa is used to allow each (j,k) category combination to be weighted according to the degree of agreement between the j^{th} and k^{th} categories. The equation becomes:⁹²

$$\kappa = \frac{\sum_{j=1}^c \sum_{k=1}^c w_{jk} (\pi_{jk} - \pi_{j.} \pi_{.k})}{1 - \sum_{j=1}^c \sum_{k=1}^c w_{jk} \pi_{j.} \pi_{.k}}$$

Where $w_{jk} = 1 - \frac{(j-k)^2}{(c-1)^2}$

For inter-rater (observer) agreement assessments quadratically weighted kappa was used. The absolute value of this coefficient was interpreted using the Landis and Koch classification of ≤ 0 to ≥ 1 as standards for strength of agreement^{74;93;94}. For this study a value ≥ 0.40 (moderate agreement and up) was considered significant.

A p-value of less than ($<$) 0.05 was considered to be significant for all statistical tests. The 95% confidence level/interval (CI) was used throughout, unless otherwise specified. The standard deviation (SD) is shown where appropriate.

All data was entered and stored in a Microsoft Excel[®] spreadsheet⁹⁵. All data analysis was conducted using SAS⁹⁶.

Chapter 4 RESULTS

4.1 Overview of the data

The overall sample size (n=1758) represents the total number of patient triage forms collected and reviewed following exclusion.

The sample included all adult patients (> 16 years age). No other patient demographics were collected.

4.2 Patient loads

The missing and scanty data, 2.6% (n=46) cases, for Thursday is removed and excluded to obtain a more accurate representation of the following results.

4.2.1 Daily

The total number of cases and frequency distribution across the remaining study days are shown in Figure 4-1 below.

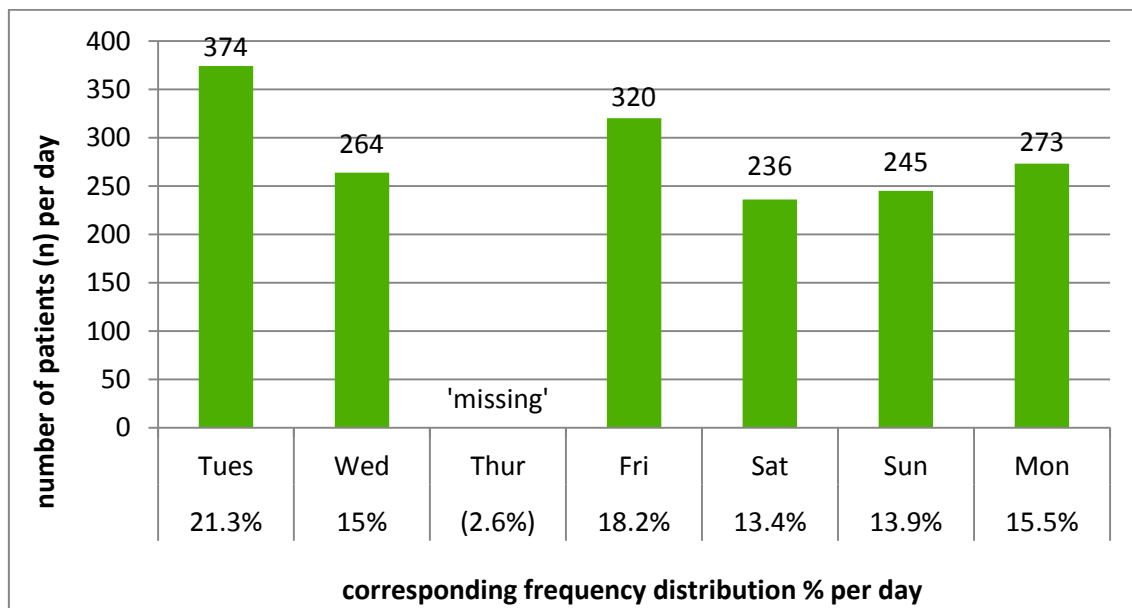


Figure 4-1: Daily patient load and frequency distribution

The mean daily patient load = 285.3 (SD 52.4) cases.

4.2.2 Hourly

The number of cases and frequency distribution across the hours of the day is shown in Figure 4-2 below. The typical pattern of ED presentation can clearly be seen.

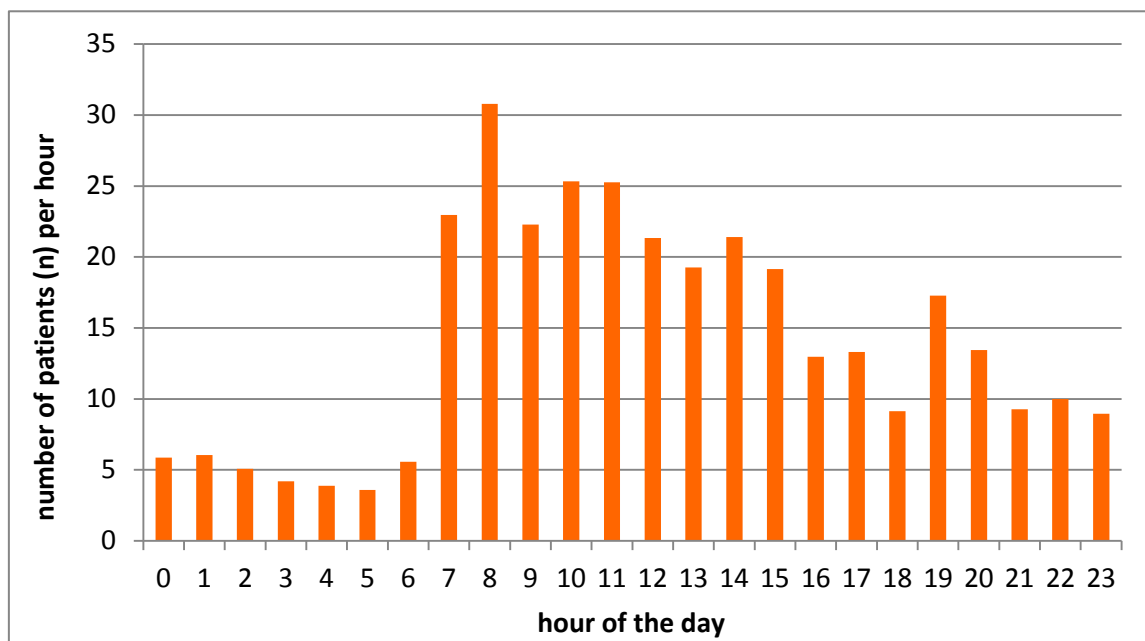


Figure 4-2: Hourly patient load and frequency distribution

The peak of presentations was in the early morning with a gradual decline throughout the rest of the day.

The mean hourly patient load = 14 (SD 8.2) presentations per hour.

4.2.3 Day versus night (12-hourly)

The 12-hourly (day versus night) patient load is shown in Figure 4-3 below.

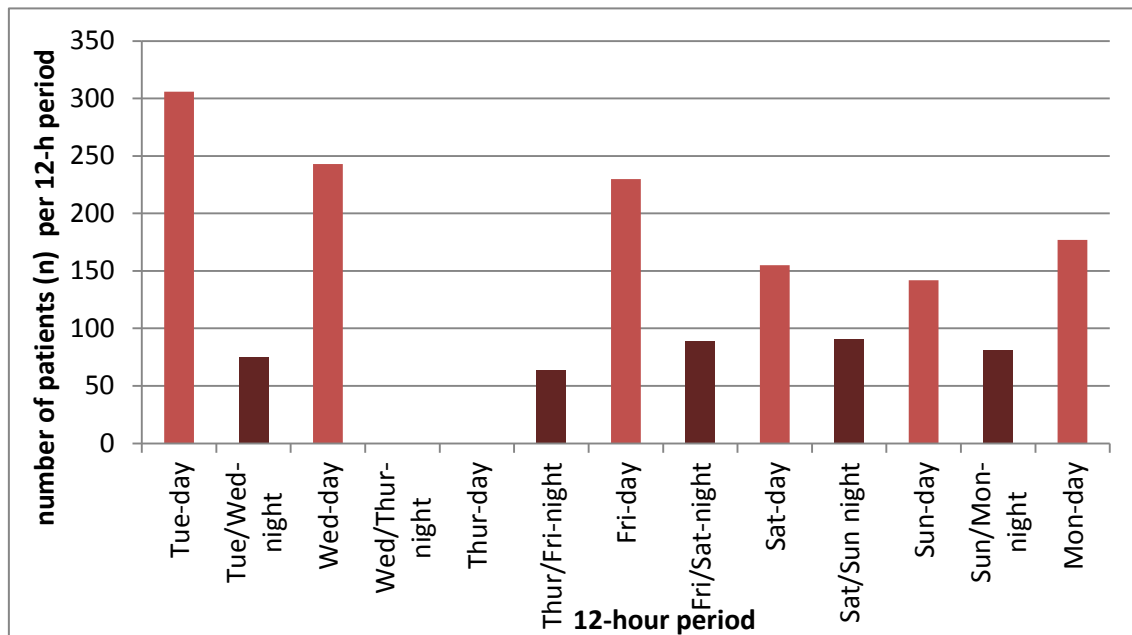


Figure 4-3: Number of patients per 12-hour period

The majority of cases (71%) presented during the daytime (07h00–18h59), 26% during the night (19h00–06h59) and the time of presentation was unknown in the remaining 3%.

The mean patient load during the DAY = 208.8 (SD 62.3) presentations per 12-hour period.

The mean patient load during the NIGHT = 80 (SD 11) presentations per 12-hour period.

An increase (difference) of 161% in the average night versus day presentations is seen.

4.3 Trier Triage

4.3.1 Trier level of qualification

The trier (TR) qualification was unknown in 51.7% (n=909) of cases. In 48.2% (n=847) of cases the TR was a Professional Nurse (PN), while in 0.1% (n=2) of cases the TR was a Staff Nurse (SN).

As a result of the large amount of missing data and the overwhelming predominance of PNs in the available data it was not possible to compare the data in respect of various levels of TR qualification.

No individual Trier was identified as performing poor patient triage.

4.3.2 Trier triage score (TEWS) data

TR triage scores (TEWS) were not documented and recorded in 59% (n=1038) of cases. For the remaining 41% (n=720) of cases with recorded TR triage (TEWS) scores the frequency distribution of TR triage scores is shown, Figure 4-4 below.

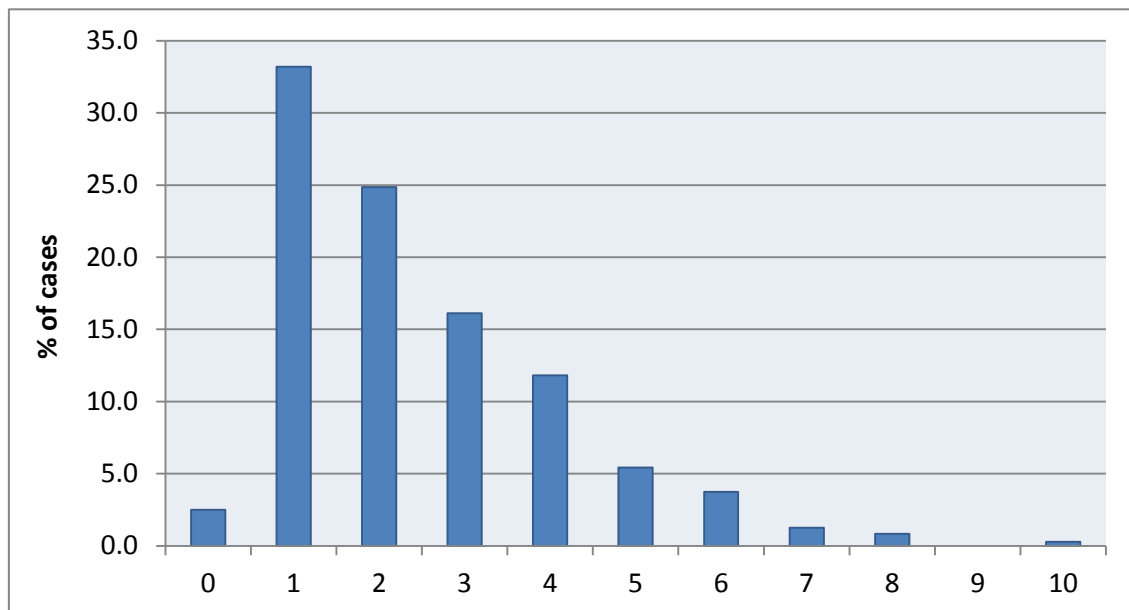


Figure 4-4: Frequency distribution of trier (TR) triage scores

4.3.3 Triageur triage colour banding data

TR triage colour banding was not recorded in 2.9% (n=51) of the cases. The frequency distribution of the remaining 97.1% (n=1707) cases is shown in Figure 4-5 below.

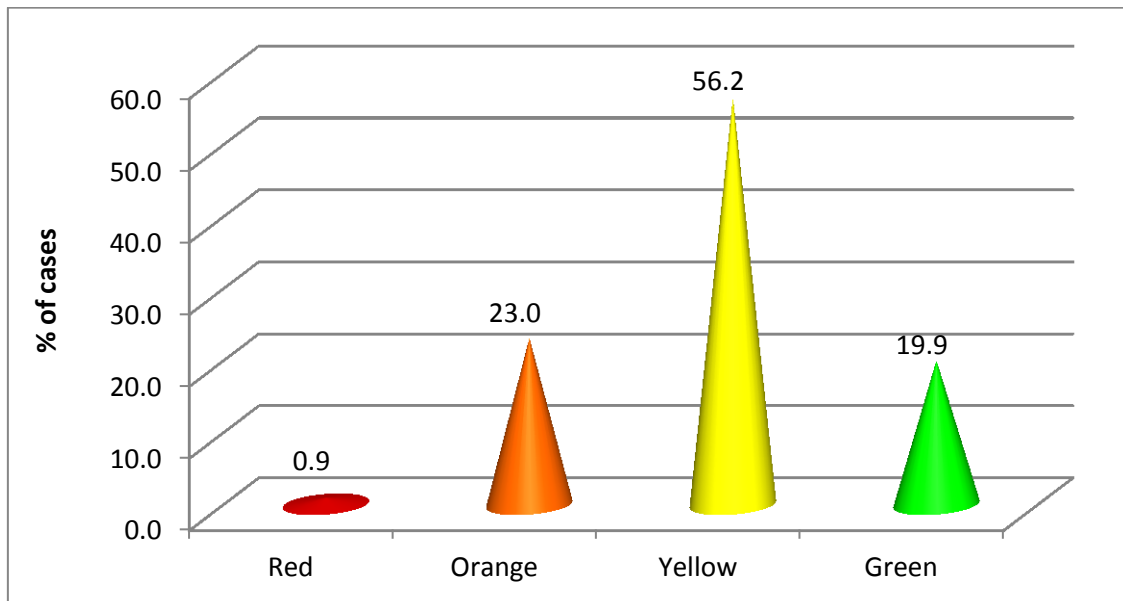


Figure 4-5: Frequency distribution of trieur (TR) triage colour banding

There were a total of 30 impossible banding assignments in the TR data, where patients were *down-triaged* compared to their triage score, as shown in Table 4-1 below. Data entries were checked and confirmed as correct.

Use of the 'Senior Healthcare Professional's Discretion' modifier was not specifically documented on any triage forms.

Table 4-1: Impossible Trier (TR) banding assignments

TR_TSCORE	TR_BAND					
	Missing	1 Red	2 Orange	3 Yellow	4 Green	Total
Missing	43	10	263	569	153	1038
0	0	0	0	6	12	18
1	3	0	10	100	126	239
2	4	0	13	120	42	179
3	1	0	28	84	3	116
4	0	0	15	68	2	85
5	0	0	28	10	1	39
6	0	1	24	2	0	27
7	0	1	7	1	0	9
8	0	2	4	0	0	6
10	0	2	0	0	0	2
Total	51	16	392	960	339	1758

4.4 Investigator Triage

4.4.1 Investigator triage score (TEWS) data

INV triage (TEWS) scores could not be determined by the investigator in 15.6% (n=275) of the cases due to insufficient data. For the remaining 84.4% (n=1483) cases the frequency distribution of the INV triage scores is shown in Figure 4-6 below.

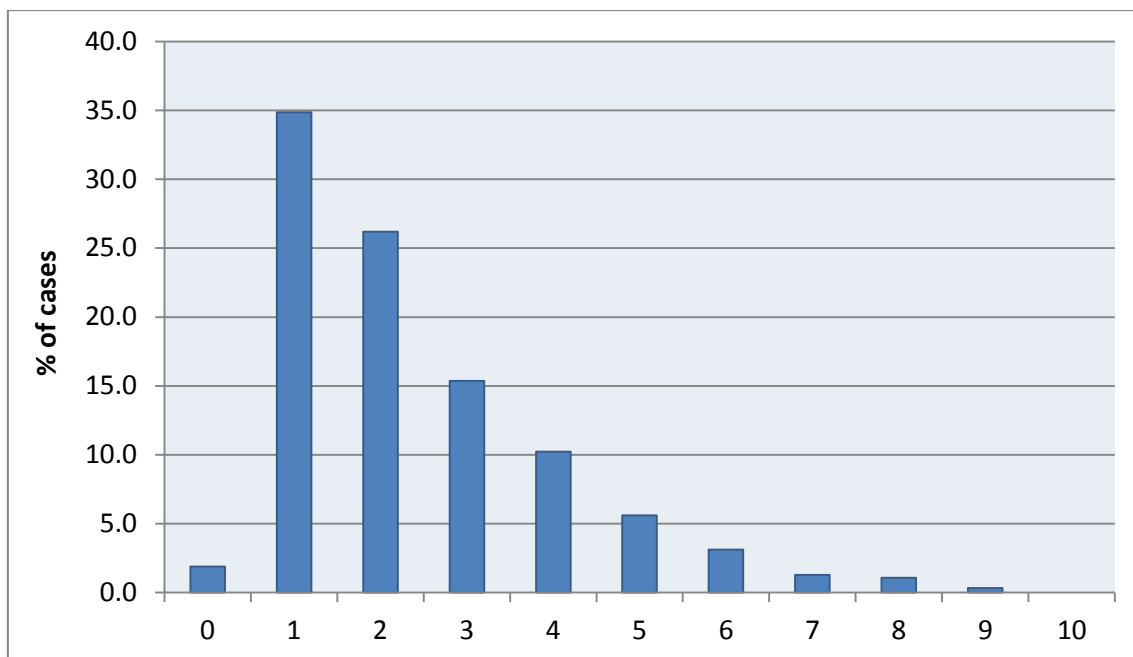


Figure 4-6: Frequency distribution of Investigator (INV) triage scores

4.4.2 Investigator triage colour banding data

INV triage colour banding could not be determined by the investigator in 11.6% (n=204) of the cases due to insufficient data. The frequency distribution of the remaining 88.4% (n=1554) cases is shown in Figure 4-7 below.

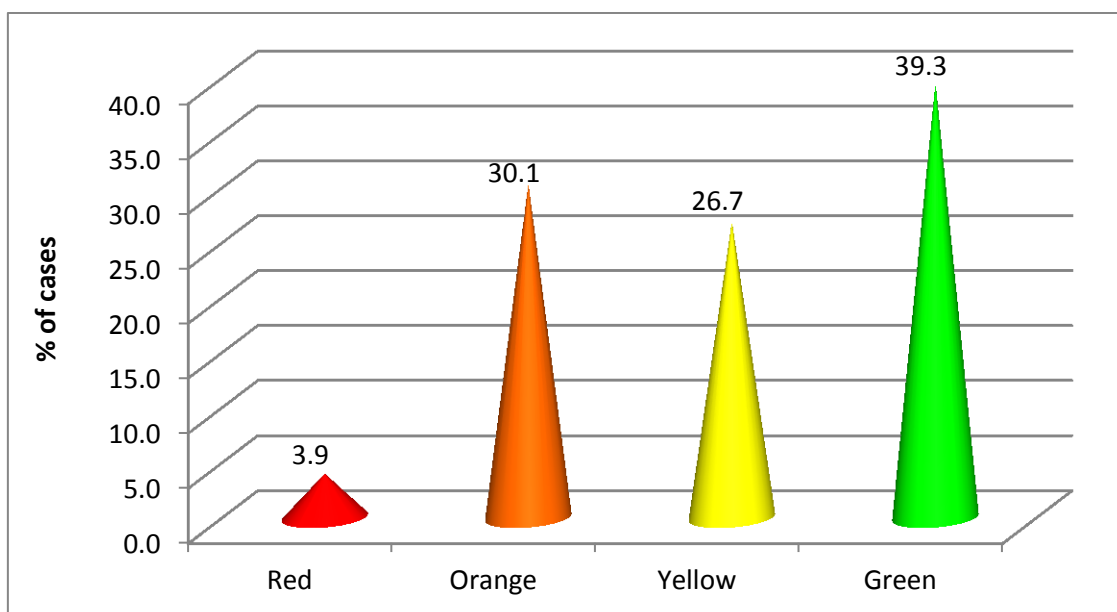


Figure 4-7: Frequency distribution of investigator (INV) triage colour banding

No impossible banding assignments (i.e. band less than indicated by triage score alone) were found in the INV data.

4.5 Inter-rater comparison of banding assignments

4.5.1 Cross tabulation

Data analysis was continued with only the cases (n=1547) for which *both* the TR and INV banding were available or could be determined, respectively.

Comparing the TR to the INV triage colour banding data the frequency distribution graphs (Figure 4-5 and Figure 4-7 above, respectively) differ somewhat.

The cross tabulation of the TR and INV banding assignments are shown as both actual frequencies and cell percentages in Table 4-2 below.

Table 4-2: Cross tabulation of the TR and INV banding assignments

Trieur Banding (TR_BAND)	Investigator Banding (INV_BAND)				
	Red	Orange	Yellow	Green	Total
Red	7 (0.45)	4 (0.26)	0 (0.00)	0 (0.00)	11 (0.71)
Orange	37 (2.39)	241 (15.58)	48 (3.10)	27 (1.75)	353 (22.82)
Yellow	16 (1.03)	201 (12.99)	315 (20.36)	362 (23.40)	894 (57.79)
Green	1 (0.06)	18 (1.16)	50 (3.23)	220 (14.22)	289 (18.68)
Total	61 (3.94)	464 (29.99)	413 (26.70)	609 (39.37)	1547 (100.00)

There was an overall percentage concordance (agreement) of 50.6% (n=783) cases i.e. correlation of the INV and TR bands in just over half the cases. Thus, the discordant results were under-triage in 20.9% (n=323) and over-triage in 28.5% (n=441) of total cases.

The quadratically weighted kappa = 0.524 (95% confidence interval: 0.450-0.598) which corresponds to *moderate* agreement was considered significant⁹³.

4.5.2 Discordant banding

The sources of discordant final triage banding discussed below are demonstrated by the actual frequency values shown in Table 4-2 above.

- The largest source of discordance was over-triage where 59.4% (n=362) of patients previously triaged as YELLOW by the TR were subsequently triaged as GREEN by the INV.
- The second largest source of discordance was under-triage where 43% (n=201) of patients previously triaged as YELLOW by the TR were subsequently triaged as ORANGE by the INV.
- 88.5% (n=54) of RED patients were under-triaged - of which 27.9% (n=17) by greater than 1 category (i.e. to yellow/green) by the TR,
- 47.2% (n=219) of ORANGE patients were under-triaged – of which 3.9% (n=18) by greater than 1 category (i.e. to green) by the TR, and
- 63.9% (n=389) of GREEN patients were over-triaged – of which 4.4% (n=27) were over-triaged by more than 1 category (i.e. to orange – no red was found) by the TR.

4.6 Investigation of causes of discordant banding assignments

4.6.1 Correlation between Investigator and Trieur triage scores

To establish the extent of over- or under-triage up to the triage score (TEWS) stage in the triage process, the correlation between INV and TR triage scores was examined.

There was a large amount of missing data for TR score. Only 46% (n=710) cases where triage score for *both* the TR and INV were available.

Comparing the TR to the INV triage score (TEWS) data the frequency distribution graphs (Figure 4-4 and Figure 4-6 above, respectively) were extremely similar.

Cross tabulation of the TR and INV triage score (TEWS) assignments (grouped by band) are shown as both frequencies and cell percentages in Table 4-3 below.

Table 4-3: Cross tabulation of the TR and INV triage score assignments

Trieur Triage Score (TR_TSCORE)	Investigator Triage Score (INV_TSCORE)				
	≥ 7	5-6	3-4	0-2	Total
≥ 7	14 (1.97)	3 (0.42)	0 (0.00)	0 (0.00)	17 (2.39)
5-6	10 (1.41)	47 (6.62)	9 (1.27)	0 (0.00)	66 (9.30)
3-4	3 (0.42)	20 (2.82)	161 (22.68)	16 (2.25)	200 (28.17)
0-2	0 (0.00)	0 (0.00)	34 (4.79)	393 (55.35)	427 (60.14)
Total	27 (3.80)	70 (9.86)	204 (28.73)	409 (57.61)	710 (100.00)

There was an overall percentage concordance (agreement) of 86.6% (n=615) cases with under-triage in 9.4% (n=67) and over-triage in 3.9% (n=28) of cases.

The quadratically weighted kappa = 0.883 (95% confidence interval: 0.830-0.935) is interpreted as *almost perfect* agreement and was considered significant⁹³.

4.6.2 Relationship between missing and recorded TR triage score (TEWS) and type of discordance

There was a significant, but weak, association between the type of discordance or concordance and whether or not the TR triage score was recorded (X^2 test: $p < 0.0001$; Cramer's $V = 0.15$).

As shown in Figure 4-8 below in the group where the triage score had *not been recorded* by the TR, but calculated by the INV from the details provided, the proportion of concordance was 9.4% lower and the proportion of over-triage was 13.7% higher, compared to the group where the triage score had been recorded.

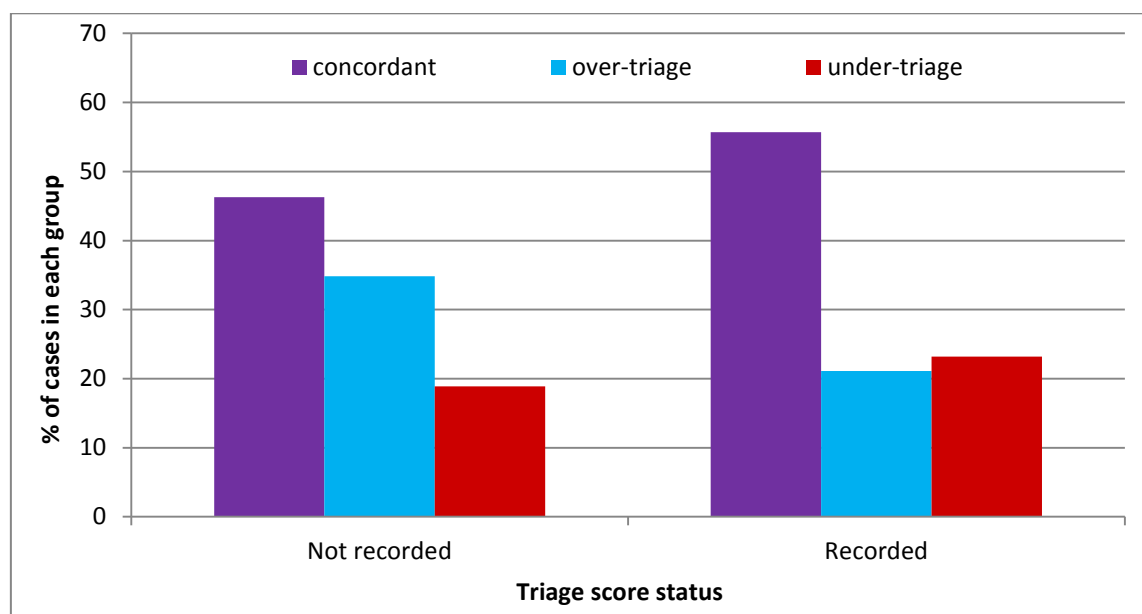


Figure 4-8: Relationship between TEWS documentation and discordance

It should also be noted that there was a significant, but weak, association between whether or not the TR triage score was recorded and the triage colour-band assigned by the TR (χ^2 test: $p<0.0001$; Cramer's $V=0.18$).

As shown in Figure 4-9 below, the proportion of patients with *no triage score recorded* was higher for ORANGE and YELLOW than for RED and particularly GREEN colour-band categories.

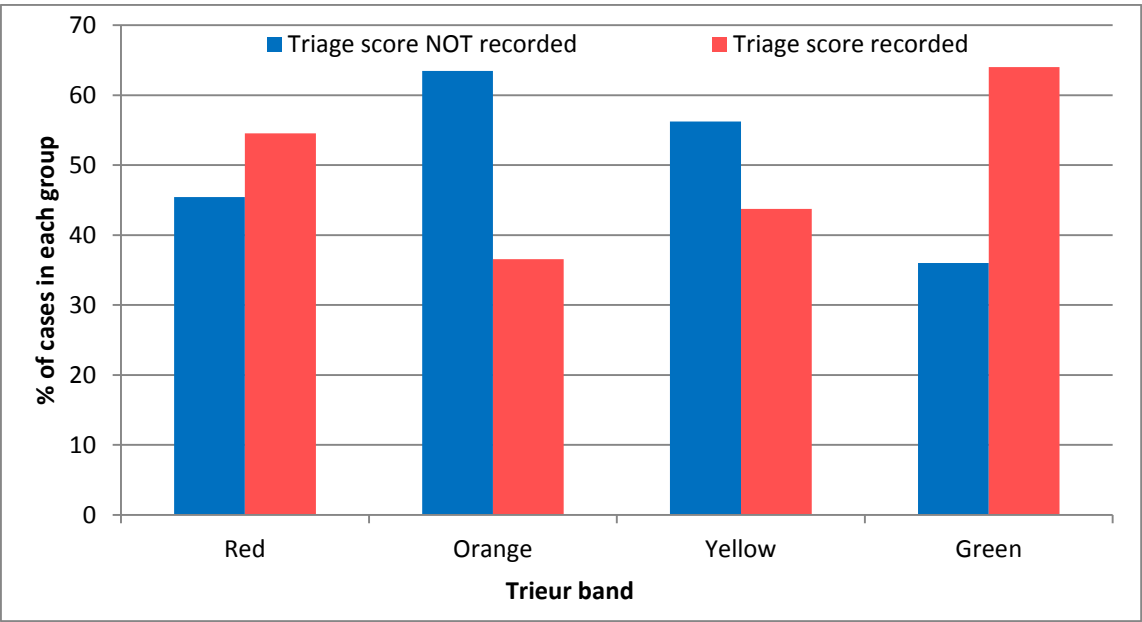


Figure 4-9: Triage score documentation within the various colour bands.

4.6.3 Relationship between discordance, over-triage, under-triage and INV banding assignment

Each measure was assessed separately since under-triage is not possible for GREEN and over-triage is not possible for RED banding categories.

- **DISCORDANCE**

There was a significant, moderate, association between concordance/discordance and INV band assignment (χ^2 test: $p < 0.0001$; Cramer's $V = 0.36$).

As shown in Figure 4-10 below, the discordance was higher in RED and GREEN than in the other bands.

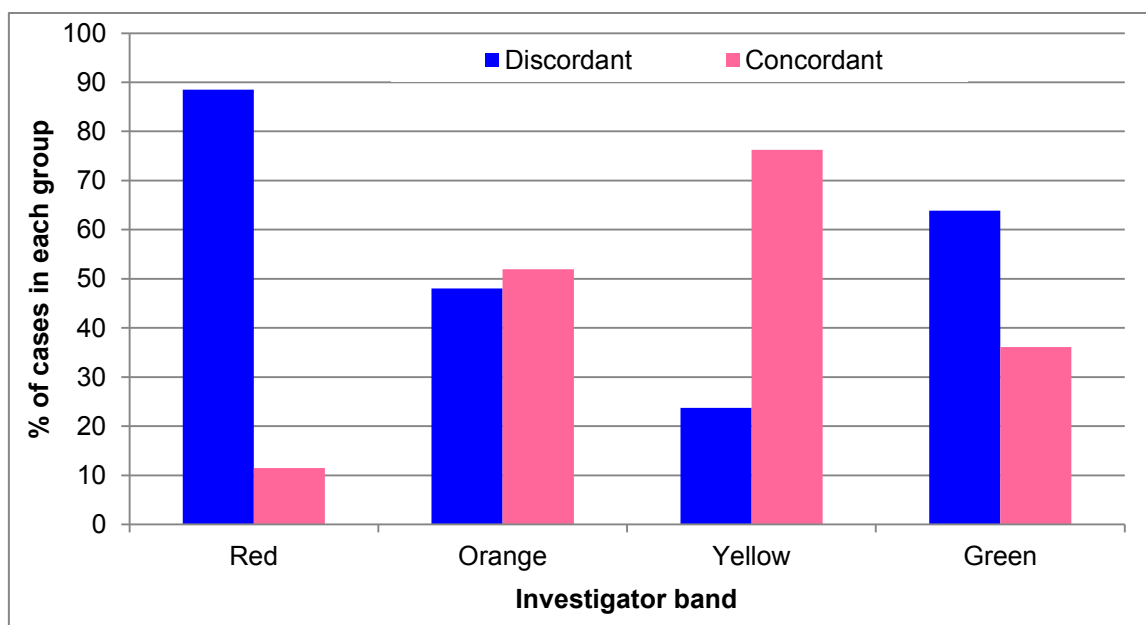


Figure 4-10: Relationship between discordance and INV banding.

- **OVER-TRIAGE**

Over-triage excluding RED banding (n=1217):

There was a significant, strong, association between over-triage/concordance and INV band assignment (X^2 test: $p < 0.0001$; Cramer's $V = 0.58$).

The level of over-triage decreased with increasing patient acuity as shown in Figure 4-11 below.

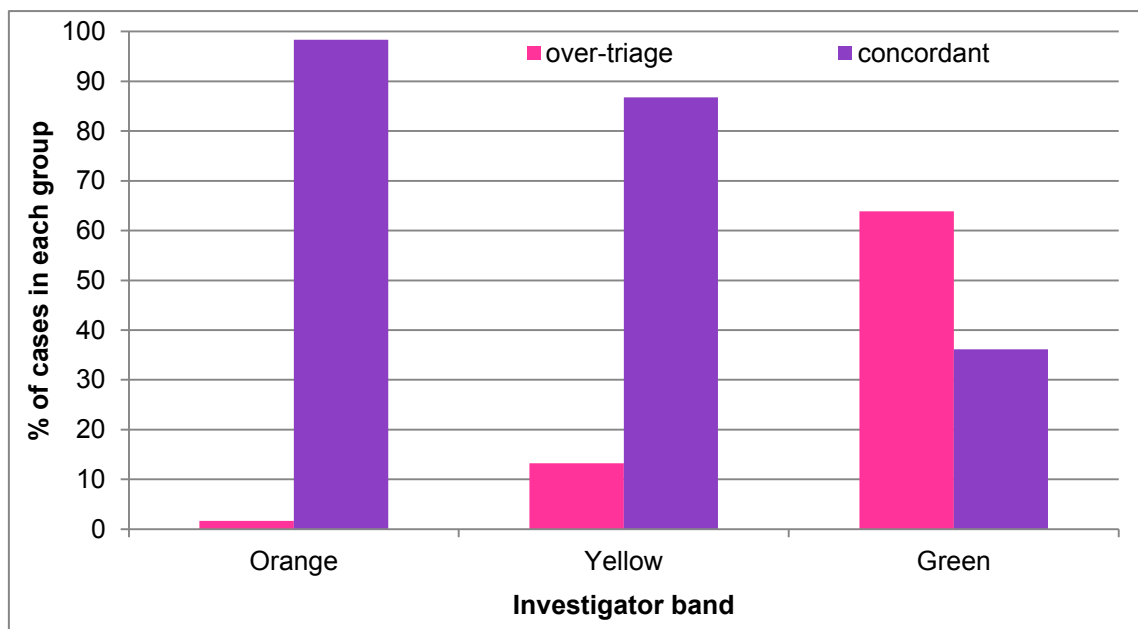


Figure 4-11: Relationship between over-triage and INV banding.

- **UNDER-TRIAGE**

Under-triage excluding GREEN banding (n=886):

There was a significant, moderate, association between under-triage/concordance and INV band assignment (X^2 test: $p < 0.0001$; Cramer's $V = 0.44$).

As shown in Figure 4-12 below, the level of under-triage increased with increasing patient acuity.

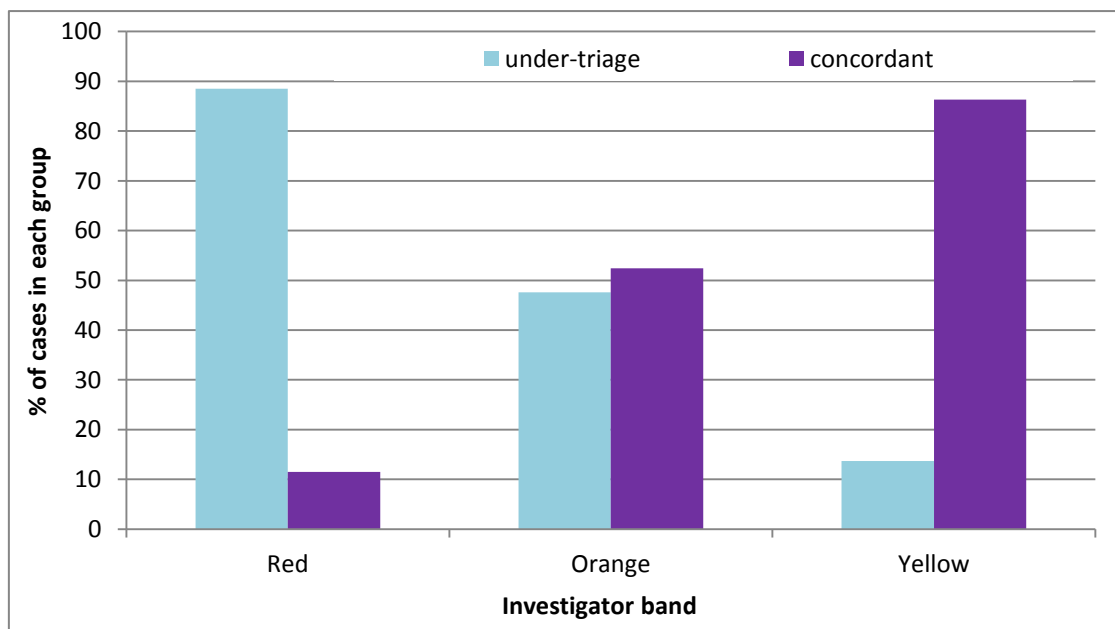


Figure 4-12: Relationship between under-triage and INV banding.

4.6.4 Relationship between the percentage discordance, over-triage, under-triage and the daily, hourly and 12-hourly patient loads.

By means of correlation analysis the relationship between the percentage (%) discordance, over-triage, under-triage and the daily, hourly and 12-hourly patient loads was assessed.

There was no significant correlation between daily patient load and % concordance ($p=0.39$), % over-triage ($p=0.97$) and % under-triage ($p=0.52$).

For the correlation analysis using hourly patient loads, hourly patient loads below 5 patients per hour were excluded due to the unreliability of such data. There was no significant correlation between hourly patient load and % concordance ($p=0.85$), % over-triage ($p=0.33$) and % under-triage ($p=0.43$).

There was also no significant correlation between 12-hourly (day/night) patient load and % concordance ($p=0.82$), % over-triage ($p=0.87$) and % under-triage ($p=0.75$).

4.7 Logistic regression and analysis

All of the above data was assembled and analysis of the discordance type (discordance/under-triage/over-triage) as a function of band; whether or not the triage score was recorded and patient loads; by means of logistic regression with concordance as the reference category was done.

Nine separate models were examined, one for discordance vs. concordance, one for over-triage vs. concordance (excluding RED), one for under-triage vs. concordance (excluding GREEN); each of these was examined in three forms: one for each measure of patient load (daily/hourly/12-hour period).

We cannot put the three measures of patient load into the model together since they are confounded. When hourly patient loads were included in the model, cases corresponding to hourly loads below 5 were excluded since the data for these cases is unreliable. The results are summarised:

4.7.1 Discordance versus concordance

None of the patient load variables was significant, so they were removed from the model. The source table for the reduced model is seen in Table 4-4 below.

Table 4-4: Source table for discordance vs. concordance

Type 3 Analysis of Effects			
Effect	DF	Wald	Pr > ChiSq
		Chi-Square	
INV_BAND	3	173.56	<.0001
tr_tscore_rec	1	13.79	0.0002

The effects of both INV band ($p < 0.0001$) and whether or not the triage score was recorded ($p = 0.0002$) were significant. The results can be expressed in terms of odds ratios as follows:

- Discordance was 4.7 times (95% CI 2.1-10.5) more likely for INV band RED than for GREEN, controlling for whether or not the triage score had been recorded. (Bearing in mind that RED cases make up only 3.9% of the data set).
- Discordance was 0.51 times (95% CI 0.40-0.66) and 0.18 times (95% CI 0.13-0.24) as likely for INV bands ORANGE and YELLOW compared to GREEN, respectively, controlling for whether or not the triage score had been recorded.
- Discordance was 1.5 times (95% CI 1.2-1.9) more likely for cases with *no recorded triage score* than for cases with a *recorded triage score*, controlling for banding.

The predicted probabilities of discordance are shown in Figure 4-13 below.

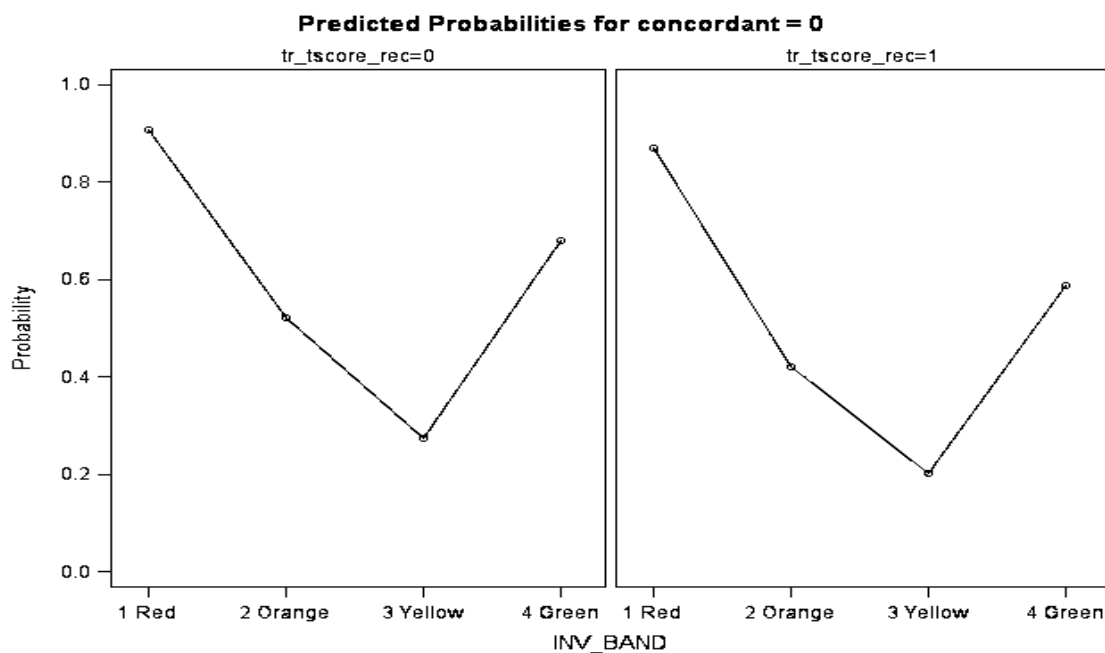


Figure 4-13: Predicted probabilities of discordance.

4.7.2 Over-triage versus concordance

The effect of patient load was significant in all three models, as were the effects of INV band and whether or not the triage score was recorded. The results were very similar, so the model for the ***hourly patient load*** is discussed. The source table for the model is seen in Table 4-5 below:

Table 4-5: Source table for over-triage vs. concordance

Type 3 Analysis of Effects			
Effect	DF	Wald	Pr > ChiSq
		Chi-Square	
INV_BAND	2	248.33	<.0001
tr_tscore_rec	1	46.50	<.0001
<i>hourly_pt_load</i>	1	12.59	0.0004

The effects of INV band ($p < 0.0001$), whether or not the triage score were recorded ($p < 0.0001$) and hourly patient load ($p = 0.0004$) were significant. The results can be expressed in terms of odds ratios as follows:

- Over-triage was 0.006 times (95% confidence interval 0.002-0.018) as likely for INV band ORANGE than for GREEN, controlling for the other variables in the model.
- Over-triage was 0.070 times (95% CI 0.047-0.102) as likely for INV band YELLOW than for GREEN, controlling for the other variables in the model.

- Over-triage was 3.0 times (95% CI 2.2-4.2) more likely for cases with *no recorded triage score* than for cases with a *recorded triage score*, controlling for the other variables in the model.
- Over-triage was 0.97 (95% CI 0.95-0.99) times as likely with every unit (1 patient) increase in hourly patient load, controlling for the other variables in the model.

The predicted probabilities of over-triage are shown in Figure 4-14 below.

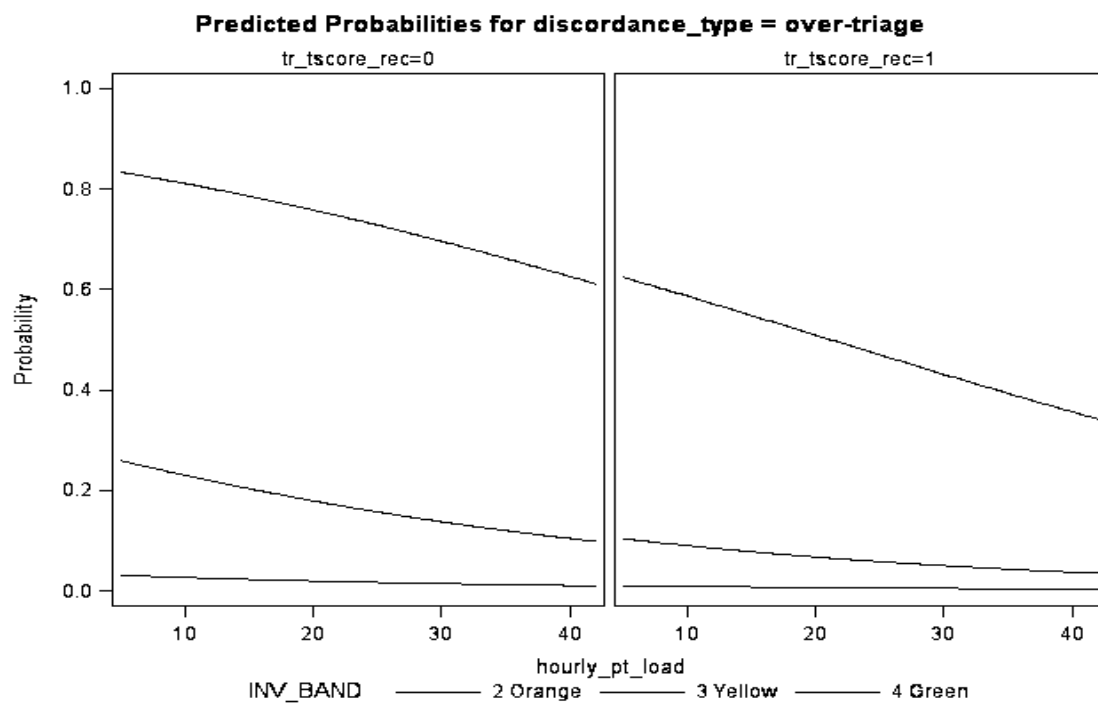


Figure 4-14: Predicted probabilities of over-triage.

4.7.3 Under-triage versus concordance

The effect of daily patient load was not significant, but the effects of hourly and 12-period patient loads were significant. The results were very similar, so the models for the hourly and 12-hourly patient load are discussed.

- **HOURLY PATIENT LOADS**

The source table for the model is shown in Table 4-6 below.

Table 4-6: Source table for under-triage vs. concordance - hourly patient loads.

Type 3 Analysis of Effects			
Effect	DF	Wald	Pr > ChiSq
		Chi-Square	
INV_BAND	2	133.69	<.0001
tr_tscore_rec	1	3.21	0.0731
<i>hourly_pt_load</i>	1	13.86	0.0002

The effects of INV band ($p < 0.0001$) and hourly patient loads ($p = 0.0002$) were significant. The results can be expressed in terms of odds ratios as follows:

- Under-triage was 61 times (95% confidence interval 24-152) more likely for INV band RED than for YELLOW, controlling for the other variables in the model. (Bearing in mind that RED cases make up only 3.9% of the data set).
- Under-triage was 6.9 times (95% CI 4.7-10.1) more likely for INV band ORANGE than for YELLOW, controlling for the other variables in the model.

- Under-triage was 1.04 times (95% CI 1.02-1.06) more likely with every unit (1 patient) increase in hourly patient load, controlling for the other variables in the model.

The predicted probabilities of under-triage for the hourly patient load model are shown in Figure 4-15 below.

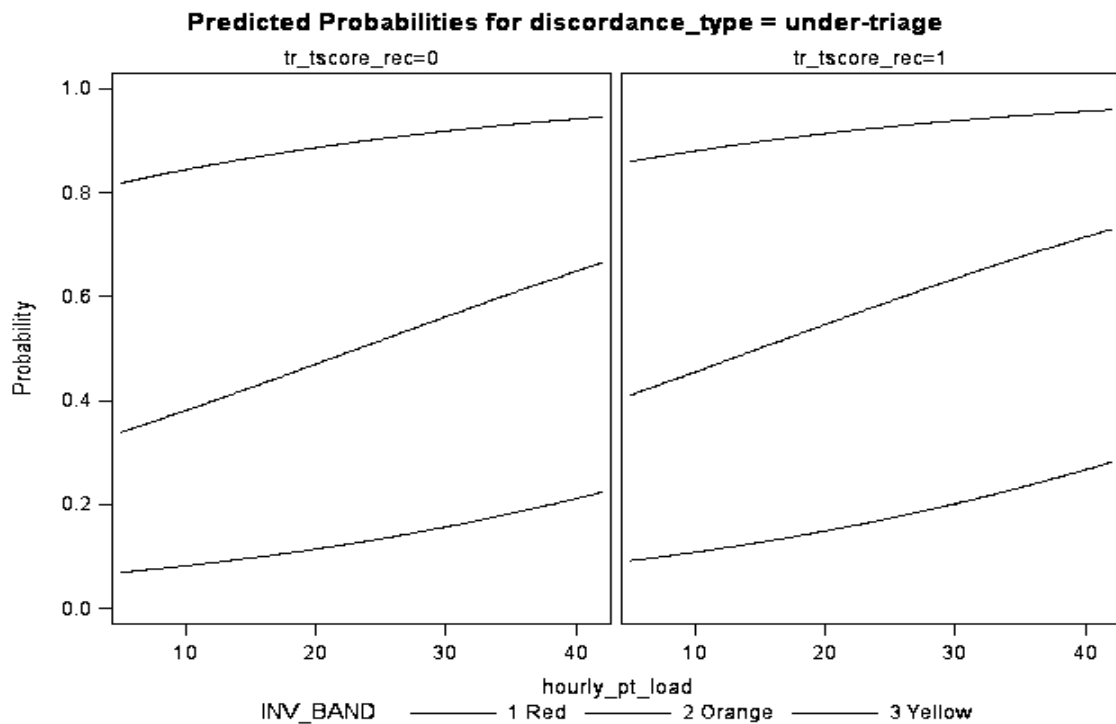


Figure 4-15: Predicted probabilities of under-triage for the hourly patient loads.

- **12-HOURLY PATIENT LOADS**

The source table for the model is shown in Table 4-7 below.

Table 4-7: Source table for under-triage vs. concordance - 12 hourly patient loads.

Type 3 Analysis of Effects			
Effect	DF	Wald	Pr > ChiSq
		Chi-Square	
INV_BAND	2	131.86	<.0001
tr_tscore_rec	1	5.31	0.0212
<i>period_pt_load</i>	1	7.15	0.0075

The effects of INV band ($p < 0.0001$), whether or not the triage score were recorded ($p = 0.021$) and 12-hourly patient loads ($p = 0.0075$) were significant. The results can be expressed in terms of odds ratios as follows:

- Under-triage was 70 times (95% confidence interval 26-186) more likely for INV band RED than for YELLOW, controlling for the other variables in the model. (Bearing in mind that RED cases make up only 3.9% of the data set).
- Under-triage was 6.6 times (95% CI 4.5-9.6) more likely for INV band ORANGE than for YELLOW, controlling for the other variables in the model.
- Under-triage was 0.67 times (95% CI 0.48-0.94) as likely for cases with *no recorded triage score* than for cases with a *recorded triage score*, controlling for the other variables in the model.

- Under-triage was 1.003 times (95% CI 1.001-1.005) more likely with every unit (1 patient) increase in 12-hourly patient load, controlling for the other variables in the model.

The predicted probabilities of under-triage for the hourly patient load model are shown in Figure 4-16 below.

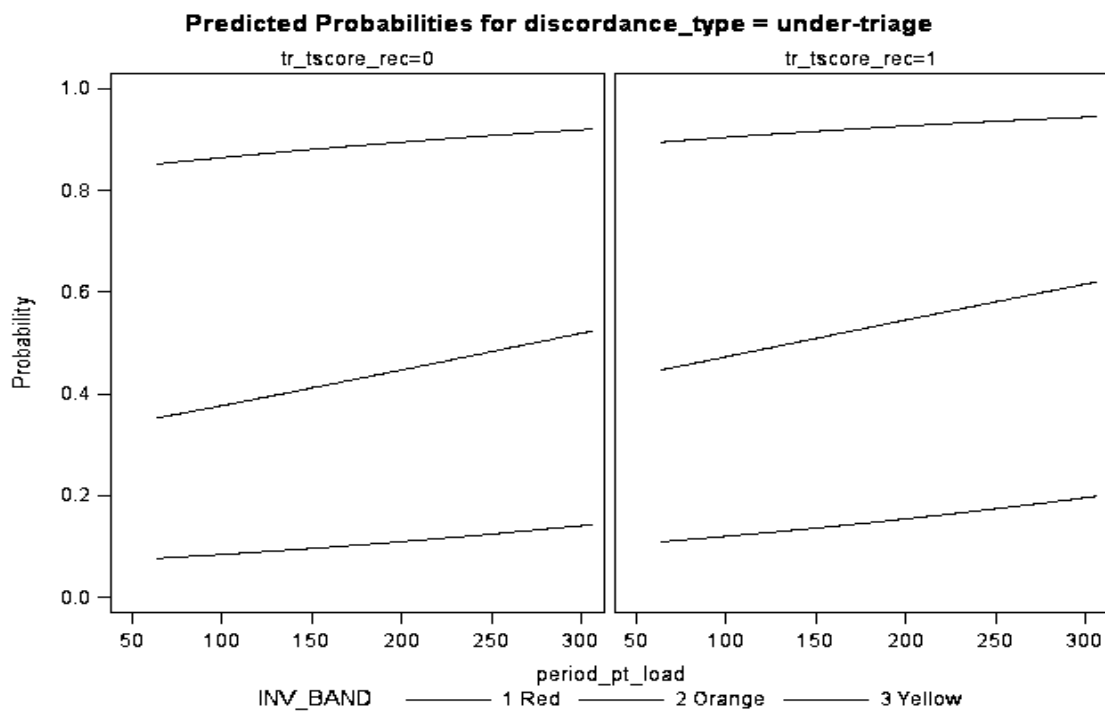


Figure 4-16: Predicted probabilities of under-triage for the 12-hourly patient loads.

Chapter 5 **DISCUSSION**

5.1 Aim

The aim of this study was to determine, evaluate and analyse the application reliability of the SATS in adult emergency cases at a central academic hospital and to determine which factors, if any, contributed to this. It has been demonstrated previously that the SATS has good inter-rater reliability^{90;91}. Using the information documented on collected patient triage forms, the SATS was applied by the INV and compared to that of the original TR. Several conditions possibly affecting concordance and discordance were isolated, analysed and reviewed. This data was compared to other international and locally available data to potentially improve patient outcomes, cost efficacy and resource management.

5.2 Temporal patterns and frequency distribution of triage patients

The greatest number of patient triage presentations was on Tuesday (21.3 percent), followed by Friday (18.2 percent) and it appears that the remaining days of the week (excluding Thursday) are almost on par with an approximate average of 14.5 percent per day. One would imagine that Thursday would follow the latter, if sufficient data were available.

The daily patient load pattern in the present study is similar to the findings of a like sized South African study by Hodkinson *et al* (2009) which reported Mondays equalling Tuesdays as the busiest days of the week, followed by Friday, with a slight taper on the remaining four days of the week⁹⁷.

They also reported an up to 25 percent increase on Mondays and Tuesdays compared to other days of the week ^{85,97}. In the present study a 31 percent increase (difference) was found on Tuesday.

The mild discrepancy in 'busy day increase' percentages may be ascribed to the fact that the study by Hodkinson *et al* (2009) was conducted at a secondary hospital ED, whilst the present study was at a central academic hospital ED. A much larger South African study by Wallis *et al* (2007) demonstrated a peak in ED patient presentations on weekends and Mondays ⁹⁸.

The mean daily patient load was 285.3 cases with an upsurge in hourly patient load from 07h00. The peak patient load hour was 08h00-09h00 which accounted for 10.8 percent of the daily average, and eight percent of the total cases across the entire study week. A persistently high mean hourly patient load of 23 patients (greater than the overall mean of 14 presentations per hour) was seen between 07h00-16h00 with a second surge at 19h00 followed by a downward drift overnight. In comparison, Hodkinson *et al* (2009) showed a somewhat similar time-of-day presentation pattern, with a peak hour of presentation 10h00-11h00 (6.9 percent of average daily presentations) ⁹⁷.

The above-mentioned present study findings and a 161 percent increase (difference) in the average day (07h00-18h59) compared to night (19h00-06h59) presentations is in contrast to a previous study by Wallis *et al* (2007) which suggested that a large proportion of the ED population present outside of normal office hours ^{85,98}. However, it may be explained by the peak hour rush as patients who would usually present for work present ill to the ED; and the slight surge in presentations at 19h00 as the public completes their workday.

Furthermore, the 08h00 and 19h00 swells may also be due to the ED Nursing Staff shift change which occurs at 07h00 and 19h00. Some ED patients may have arrived earlier but be postponed due to the backlog whilst nursing staff perform hand-overs between shifts.

5.3 Triageur level of qualification

The level of qualification of the TR was unknown in 51.7 percent of cases, and almost entirely Professional Nurses (PNs) in the remaining cases. It was not possible to deduce any further value from this variable statistically.

It is unclear why such a low proportion of TR level of qualification was recorded. Perhaps the busy triage environment and implied swiftness is the reason many trieurs 'forget' to sign the forms. Alternatively, maybe a fear of embarrassment and reprimand for incorrect triage decisions exists amongst trieurs. This would need to be further investigated.

In the present study perhaps the vital sign measurements and documentation was performed by junior nurses or nursing students who may or may not have transferred the information onto the TEWS. The PN appears to have made the final triage decision, signing the triage form. If this is true it may prejudice the veracity of the study data and warrants further investigation and attention.

Alternatively, the remaining 51.7 percent of unsigned triage forms may have been completed by less experienced nursing personnel that were not confident enough or unwilling to commit their names to the triage form.

This is a major limitation to the study. Since no deductions could be made and analysis of ED experience or formal training numerous was not possible, literature studies were reviewed and are discussed below.

Several local studies by Twomey *et al* (2011, 2012) report excellent inter-rater reliability of SATS within individual cadres of HCPs and acceptable inter- and intra-rater reliability amongst EPs and ENAs alike ^{90;91}. Furthermore, worldwide triage systems have been designed, developed, and verified as tools to assist in determining patient acuity ⁷⁵. They rely on nurses with an advanced level of experience, expertise and good judgement to run successfully ^{46;60;75;77}. Significant evidence exists that nursing experience alone is invaluable and correlates with triage efficacy ^{46;59-61;78}.

The Emergency Nursing Association (ENA) and ACEP recommend that experienced registered nurses with substantiated clinical judgement and decision making skills, including a minimum of six months ED work experience, may perform triage ^{58;75}. Cone *et al* (as cited by Forsgren *et al* 2009) recommends at least one year ED work experience and adequate formal triage training ⁶⁰.

The SATG supports the use of the SATS for triage by any category of nursing staff, with the proviso that specific and adequate training has been received ⁶¹. Adequate training is not further defined by Augustyn (2011) ⁶¹.

No individual Trier was identified as performing poor triage thus there was no need for additional intervention in terms of a triage refresher course. This is separate from the overall recommendations made regarding triage training and updates.

5.4 Inter-rater comparison – Trieur vs. Investigator

5.4.1 Triage score (TEWS) data

The TR triage score (TEWS) calculation and documentation was low, present in only 41 percent of cases.

If the majority of final triage decisions were made by PNs then the low percentage of recorded triage scores may perhaps be attributed to the tradition that intuition and triage go hand in hand ⁴⁶. Despite objective triage principles and measures, recent research highlighted by Yurkova *et al* (2011) declares that there is “an over-reliance on intuition and an under-reliance on physiologic cues” to establish patient acuity ³⁹. Additional studies cited by Vatnoy *et al* (2012) suggest that despite proof of better predictive triage, higher inter-rater reliability and improved patient safety, vital sign parameters are often overlooked and discounted ⁹⁹.

Experienced nurses’ triage consists of complex reasoning strategies subject to intuition, confidence, critical cue recognition, knowledge base, patient behaviour; systematically avoiding formal algorithms; and adopting an individual *holistic assessment* based on previous experience ^{75;99-101}.

According to Schrader *et al* (2013) a considerable subjective component still exists in triage and Considine *et al* (2004) adds that visual cues (clinical appearance) form a central component thereof ^{47;102}.

In case the majority of final triage decisions were made by other less experienced ED nurses (SN/NA) then the high percentage of unrecorded triage scores may perhaps be attributed to the fact that the TEWS may not have been calculated.

They may not have been exposed to adequate training and interpretation of the SATS from more senior experienced nurses who possibly rely on the aforementioned holistic assessments that furthermore may vary from senior nurse to senior nurse depending on who is on duty at the time. If this were true it would suggest a lack of standardised triage approach or protocol, casting doubt on the validity of the study data.

When comparing TR and INV triage score data the frequency distribution graphs were extremely similar. The overall concordance was 86.6 percent; total discordance was 13.4 percent with a quadratically weighted kappa = 0.883, demonstrating an almost perfect agreement⁹³. A percentage of 9.5 were under-triaged and 3.9 percent cases were over-triaged.

Although, the comparison was only performed on the subgroup of cases triage score was recorded by both the TR and INV (46 percent of the total data set), the metrics are much better than those for the band assignments. This suggests the following:

- Discordant triage occurred largely after the assignment of the triage score when looking at the discriminators
- Discordant triage was influenced by the lack of a calculated or recorded triage score
- The INV was not able to assign the true band due to missing discriminator information

It appears that when the TEWS triage score is calculated and documented there is good concordance and inter-rater agreement.

5.4.2 Triage colour banding data

The documentation of colour banding (97.1 percent) by the TR was more than double that of TR triage score. This may be the result of the triage acuity assessment and assignment being based on said 'intuition-driven triage'. The aforementioned and perhaps the impossible banding assignments may be the result of the 'Senior Healthcare Professional's Discretion', although not specifically documented.

Comparing the TR to the INV triage colour banding data the frequency distribution differs somewhat.

The combined TR colour banding frequency distribution (green and yellow 76.1 percent; red and orange 23.9 percent) followed data described in numerous local studies by Hodkinson *et al* (2009) (green and yellow 71 percent; red and orange 29 percent), Hanewinckel *et al* (2010) (green and yellow 80.8 percent; red and orange 19.2 percent), Twomey *et al* (2011) (green and yellow 75 percent; red and orange 27 percent) and international studies cited by Barfod *et al* (2010) (green and yellow 74.2 percent; red and orange 25.8 percent), as presented in Table 5-1 below^{85;90;97;103}.

An overall preponderance of yellow triage patients was further in keeping with Hodkinson *et al* (2009), Wallis *et al* (2007), Hanewinckel *et al* (2010) and Barfod *et al* (2010)^{85;97;98;103}. The similarity in the frequency distribution (size) of the orange ~ green categories is demonstrated in studies by Hodkinson *et al* (2009), Wallis *et al* (2007) and Hanewinckel *et al* (2010)^{85;97;98}.

The 0.9 percent incidence of category red patients is uncharacteristically low and less than half that found by the INV and all other studies cited above, as shown in Table 5-1 below. Perhaps this is partly due to the overall under-triage of 88.5 percent red patients, of which 27.9 percent were under-triaged by greater than one category.

Table 5-1: Comparison of triage colour banding frequency distribution between present study and other related studies

Triage banding	Present Study		Hodkinson <i>et al</i> (2009) (97)	Wallis <i>et al</i> (2007) (98)	Hanewinkel <i>et al</i> (2010) (85)	Barfod <i>et al</i> (2010) (103)	Twomey <i>et al</i> (2011) (90)
	TR	INV					
Green	19.9	39.3	23	30.3 **	13.9	31.5	50
Yellow	56.2	26.7	48	34.1 **	66.9	42.7	25
<i>Subtotal</i>	<i>76.1</i>	<i>66</i>	<i>71</i>	<i>64.4 **</i>	<i>80.8</i>	<i>74.2</i>	<i>75</i>
Orange	23.0	30.1	27	30.9 **	14.3	22.7	24
Red	0.9	3.9	2	4.1 **	4.9	3.1	3
<i>Subtotal</i>	<i>23.9</i>	<i>34</i>	<i>29</i>	<i>35 **</i>	<i>19.2</i>	<i>25.8</i>	<i>27</i>
Sample size (n)	1707	1554	2399	11897	1147	6911	34
Study population	Adult	Adult	Adult	Adult	Mixed*	Mixed*	Mixed*

* Mixed study population that includes adult and paediatric cases

** Average frequency distribution of data from four HC facilities

In comparison, the combined INV colour banding frequency distribution (green and yellow 66 percent; red and orange 34 percent) was in keeping with a large scale local study by Wallis *et al* (2007) (green and yellow 64.4 percent; red and orange 35 percent), as presented in Table 5-1 above ⁹⁸. An overall preponderance of green triage category patients was in keeping with Twomey *et al* (2011), while the similarity in the frequency distribution (size) of the orange ~ yellow categories is demonstrated by both Wallis *et al* (2007) and Twomey *et al* (2011) ^{90;98}.

The overall triage findings were almost akin to that of Considine *et al* (2004). Concordance with 'expected triage decisions' of 50.6 percent (61 percent Considine *et al*), total discordance was 49.4 percent with under-triage 20.9 percent (18 percent Considine *et al*) and over-triage 28.5 percent (21 percent Considine *et al*), and a moderate agreement in keeping with studies by Durand *et al* (2011) and Grossman *et al* (2012) ^{6;102;104}.

The inter-rater comparison of TR and INV findings suggest that the largest sources of discordance was the over-triage of 59.4 percent green patients to yellow and under-triage of 43 percent orange patients to yellow. This may explain the above-mentioned overall preponderance of yellow patients by the TR.

5.5 Discordance

Discordance, or mis-triage, is defined by Twomey *et al* (2012) as "the extent of over- or under-triage relative to true acuity" ⁶⁴. Internationally, and in SA, deemed standards include the American College of Surgeons Committee on Trauma's (ACSCOT) accepted average rate for under-triage of no more than 10 percent (range 5-10 percent) and over-triage of up to 50 percent (range 30-50 percent)

^{17;57;64;105;106}.

The present study results of 20.9 percent under-triage exceeds that of ACSCOT and various South African studies by Twomey *et al* (2012), Rosedale *et al* (2011) and Govender *et al* (2012) of less than 10 percent ^{57;64;105}. However, the over-triage rate of 28.5 percent was in line with the aforementioned international and local studies of less than 50 percent.

Considerable inconsistency in triage assessment persists, triggered by the smorgasbord of factors determining individual patient urgency and acuity, as demonstrated in a study by Fitzgerald *et al* (2010) ⁴⁶.

To summarise from the literature: mis- or incorrect triage assignment to an inappropriate acuity category plays a crucial role in the potentially negative effects on ED patient care processes and outcome ^{39;51;62;75;107;108}. Précised by Wollaston *et al* (2004), medical intervention is either “unacceptably delayed (under-triage) or unnecessarily expedited (over-triage)” ¹⁰⁹.

5.5.1 Over-triage

Twomey *et al* (2012) and Rankin *et al* (2013) summarise that over-triage further stretches financial and resource constraints thereby indirectly imposing on patient care outcomes as limited resources are diverted, inappropriately rationed and gratuitously over consumed ^{64;108}.

The present study’s general over-triage rate of 28.5 percent noted above was within the accepted standard. This result may be due to missing relevant data from the patient triage forms as the INV would not be fully aware of the true patient acuity, which may have been higher than represented by the recorded and available data.

In addition, possible mismeasurement of vital parameters, miscalculation of the TEWS, ambiguity in the use of discriminators, or an overall misinterpretation and misapplication of SATS triage rules by the TR may have occurred and is considered a limitation of the study.

Since many patients referred to the central academic hospital in this study were previously seen by other HC practitioners or centres, the ED triage nursing personnel may have ‘taken pity’ and *up-triaged* them regardless of the triage findings, ensuring that they would be attended to. The overall over-triage of 63.9 percent green patients, of which 4.4 percent were over-triaged by greater than one category to orange, infers significant overspend of HC and ED resources. Bullard *et al* (2008) and Rankin *et al* (2013) comment that over-triage errs on the side of patient safety and is encouraged, essential and appropriate if in addition to clinical instincts, the patient appears worse than the assigned triage score implies, regardless of whether the higher triage score criteria are met in full ^{108;110}.

Moreover, if the present study’s over-triage rate was greater (yet still below the 50 percent standard limit) it would allow for a decrease in the unacceptably high under-triage rate discussed below.

5.5.2 Under-triage

Major concern exists and was shared by Twomey *et al* (2012), regarding the implied and associated adverse effects of under-triage which include: increased patient waiting times, delayed emergency and definitive care, and increased morbidity and mortality ⁶⁴.

The present overall under-triage rate of 20.9 percent noted above is more than double the accepted standard. Unrecorded patient triage data is unlikely to be the cause, since it would be improbable that the INV interpreted *invisible additional data* and subsequently raised the triage banding level assigned.

In this light, the under-triage rate of red (27.9 percent) and orange (3.9 percent) patients by more than one category as the largest combined source of discordance is a significant finding. In comparison to Twomey *et al* (2012) which noted under-triage of red patients (22 percent) by one category only, and a similar proportion of orange patients (4 percent) by more than one category ⁶⁴.

Overall the red category of patients comprised a small portion (3.9 percent) of the total sample size, in keeping with numerous studies by Hodkinson *et al* (2009), Wallis *et al* (2007), Hanewinkel *et al* (2010), Twomey *et al* (2011) and Barfod *et al* (2010), as shown in Table 5-1 above ^{85;90;97;98;103}. Irrespective of the aforementioned, the under-triage of these patients has enormous clinical implication on patient outcome, morbidity and mortality, particularly if a patient who should have received immediate medical intervention is under-triaged to a potential waiting time of four hours. Even if the SATS “Senior Healthcare Professional’s Discretion” modifier is applied, it is unlikely that a patient would be ‘down-graded’ by greater than one category.

In this study, it is supposed that if the INV could ably triage the patient as red acuity level based on the existing documented triage information. This implies the possible mismeasurement of vital parameters, miscalculation of the TEWS, ambiguity in the use of discriminators, or an overall misinterpretation and misapplication of SATS triage rules by the TR.

5.5.3 Over-triage vs. under-triage

Maningas *et al* (2006) states that from a risk perspective under-triage is the greater evil, while from an operational (input, throughput, and output) perspective over-triage is the greater evil ¹⁰⁷.

5.6 Factors affecting discordance and their predicted probabilities

5.6.1 Unrecorded triage score

Where the triage score had not been recorded the concordance decreased by 9.4 percent and discordance (over-triage) increased by 13.7 percent when compared to cases where the triage score had been calculated and recorded. A review of the literature did not yield additional information. By inference then, it seems that recording the calculated TEWS triage score prior to reviewing the discriminator list appears to improve inter-rater reliability and reduce over-triage rates. However, whether this applies to all Triageurs is unclear since methodological limitations restricted full use of the triage measuring tool by the investigator. Thus, further research and investigation is required to determine the full validity of the aforementioned statement.

In addition, the proportion of cases where no triage score was recorded was higher for the orange and yellow levels of acuity and it appears that it is easier to identify the red ($TEWS \geq 7$) and green ($TEWS \leq 2$) groups. Perhaps intuition-driven triage predominates over following the correct triage process within the midrange triage score values.

The predicted probability values for cases with *no recorded triage* score include:

- discordance was 1.5 times more likely
- over-triage was 3 times more likely
- under-triage was 0.67 times as likely

5.6.2. Level of triage acuity

- **DISCORDANCE**

Current findings of increased discordance within the red and green levels of triage acuity concur with the Considine *et al* (2004) findings, that the 'extreme ends' along the acuity spectrum are prone to increased inconsistency in triage decisions¹⁰². This is perplexing since the margin of error is reduced in both these groups with over-triage and under-triage being unfeasible in the red and green categories respectively. The aforementioned may perhaps prevent under-triage in the red group from being counter balanced by over-triage and vice versa within the green group.

Additionally, maybe the risk and cost implication in earmarking patients as red or green in terms of the need or lack of need for immediate medical intervention, resources, and admission and the possible fear of getting it wrong may perhaps sway the ED triage personnel to take the middle road and assign patients to orange or yellow acuity levels, a perceived safety stopcock.

While international consensus exists regarding the possible threat of discordance, specifically under-triage to patient safety or outcome and over-triage to the frugal use of resources, Richardson *et al* (2009) (as cited by Yurkova *et al* 2011) comments that despite accurate triage and patient acuity assignment, enhanced patient flow, and prompt patient care, better outcomes are not necessarily guaranteed ³⁹.

The predicted probability values for discordance and levels of triage acuity include:

- discordance was 4.7 times more likely for red than green
- discordance was 0.51 times as likely for orange than green
- discordance was 0.18 times as likely for yellow than green

It should be noted that the red cases constitute only 3.9 percent of the data set.

- **OVER-TRIAGE**

The largest proportion of over-triage occurred in the green acuity category (63.9 percent) and the level of over-triage decreased with increasing patient acuity. This was concordant with the Considine *et al* (2004) study where 67 percent of the patients in the green acuity category were over-triaged ¹⁰².

He proposed that triage nurses may be hesitant to categorise patients, who can safely wait for care, as green ¹⁰². Additionally, as the level of acuity increases, so the number of remaining acuity levels to over-triage patients to reduce and broadly decreases over-triage. The patients with higher acuity conditions present congruently ill and possibly facilitate the appropriate allocation of the triage acuity levels.

The predicted probability values for over-triage and levels of triage acuity include:

- over-triage was 0.006 times as likely for orange than green
- over-triage was 0.070 times as likely for yellow than green

• **UNDER-TRIAGE**

The greatest frequency of under-triage occurred in the red acuity category (88.5 percent) and the level of under-triage increased with increasing patient acuity, in keeping with the Considine *et al* (2004) general findings of 46 percent ¹⁰².

Comparatively though the current study figure (proportion cases within the group) was almost double accentuating the markedly high level of under-triage revealed in this study.

This phenomenon may be due to the fact that a greater proportion of South African patients are of a higher triage acuity as cited by Rosedale *et al* (2012) ⁵⁷.

Conversely however, this adds gravity to the aforementioned concern around excessive under-triage.

Considine *et al* (2004) purported that either triage nurses are able to identify but are tentative to assign patients to the red category or they experience difficulty identifying such patients ¹⁰². The latter statement contradicts the above-mentioned submission that patients of higher acuity present congruently ill and possibly facilitate the appropriate allocation of triage colour banding.

Grossman *et al* (2012) listed inappropriate interpretation of vital signs and disregard of high risk circumstances as the leading causes for under-triage ¹⁰⁴. Forsgren *et al* (2009) named knowledge deficit and inexperience as the leading causes of ambiguity amongst triage nurses ⁶⁰.

The predicted probability values for under-triage and levels of triage acuity in the hourly patient load model were:

- under-triage was 61 times more likely for red than yellow
- under-triage was 6.9 times more likely for orange than yellow

It should again be noted that the red cases constitute only 3.9 percent of the data set.

The predicted probability values for under-triage and levels of triage acuity in the 12-hourly patient load model were:

- under-triage was 70 times more likely for red than yellow
- under-triage was 6.6 times more likely for orange than yellow

It should again be noted that the red cases constitute only 3.9 percent of the data set.

5.6.3 Patient Loads – daily, hourly, 12-hour period

Publications by Fitzgerald *et al* (2010) and Schrader *et al* (2013) draw attention to a myth, the expectation of a surge in under-triage during times of increased ED activity and patient load ^{46;47}. In the present study there was no significant correlation between the daily, hourly and 12-hourly patient load and the proportion of concordance, over-triage and under-triage.

This was concordant with Qureshi (2010) who states that ED load and level of activity has no great impact on triage ³¹.

The predicted probability values for varying patient loads include:

- over-triage was 0.97 times as likely with every unit (1 patient) increase in hourly patient load
- under-triage was 1.04 times more likely with every unit (1 patient) increase in hourly patient load
- under-triage was 1.003 times more likely with every unit (1 patient) increase in 12-hourly patient load

5.7 Limitations of this study

Potential major limitations of this study are the possible mismeasurement of vital parameters, miscalculation of the TEWS, ambiguity in the use of discriminators, or an overall misinterpretation and misapplication of SATS triage rules by the TR which would prejudice the accuracy of study data.

This was a retrospective study and missing data for 10 March 2011 and any other incomplete triage form data may somewhat obscure results.

Moreover, the INV was not privy to observing and assessing the presenting patients' clinical appearance and varying levels of acuity, in real-time. Thus the subjective component of the triage process was absent. It is controversial whether this is a potential limitation or strength. The INV was also not influenced by the factors and conditions reviewed and considered, potentially influencing the reliability (discordance, over-triage, and under-triage) of triage.

FitzGerald *et al* (2010) summarises that it is challenging to capture or replicate the complexity of triage in writing and retrospective analysis is dependent on the reliability of available records and lacks the cues of the 'live' situation ⁴⁶.

Missing TR signature documentation made it impossible to determine and further evaluate inter-rater agreement (concordance versus discordance) amongst the different levels of nursing qualification. This is a major study limitation since the study may essentially have assessed the status quo of the application reliability of the SATS at CHBAH.

The INV acted as the sole 'control' and no true consensus by a control group or panel of experts (Delphi method) existed. Accordingly, there was no means of governance for the INV triage score and banding. Additionally, according to Govender *et al* (2012) the "doctor's opinion may not be the best gold standard with which to judge triage of emergency patients" ¹⁰⁵.

Despite being widely used to assess, estimate and quantify the level of inter-rater agreement and reliability kappa coefficients (both weighted and unweighted) are not without a number of limitations⁹¹. Kappa provides a chance-corrected measure of agreement⁹². The quadratically weighted kappa is frequently used to evaluate the reliability in ordinal scales and “weight disagreements according to magnitude of discrepancy”^{91;92}. However, the disadvantages of the quadratically weighted kappa statistic and its limited generalisability across study settings have been highlighted in the literature⁹¹. Studies by Twomey et al (2012) list these as: dependence on the number of categories; dependence on the frequency distribution of cases; providing a general estimate of agreement across all (not specific) categories and thus offering a one-dimensional overview^{64;91}.

Data collection was performed for the period 8 March 2011 – 14 March 2011. This was prior to the advent of the adult SATS chart © 2012 (see Appendix E). The CHBAH ED Triage Protocol consisted of the SATS ©2008 (see Appendix C) at the time of data collection, hence the reason the INV applied the same measuring tool.

The researcher acknowledges the potential bias inherent in the study approach and above-mentioned limitations.

5.8 Strengths of this study

An extensive literature review was performed and several studies in the South African setting, particularly in the Western Cape and Kwazulu-Natal, were found. However, there was very little data from the Gauteng province. The present study may shed some light on and provide some means of comparison amongst provinces and local HC systems.

Useful information to audit the individual institution's triage reliability and performance was obtained which may be constructive in instituting possible amendments, fine-tuning and improving overall triage processes such as patient outcomes and resource optimisation.

Furthermore, since triage is an essential and controversial component of EM, it makes for an important element of teaching and training for medical HCPs alike. Lastly, the large sample size gives added weight to the present study results and findings despite missing data.

Chapter 6 **CONCLUSIONS**

There is a need for quality driven excellence in emergency medical care worldwide, and SA is no exception^{84;111}. Continuous review, revision and redress of ED processes are required with accurate, reliable and efficient triage at its core^{7;84;111}.

The application reliability of the South African Triage Score/Scale (SATS) in adult emergency cases at a central academic hospital was evaluated and possible contributing factors influencing this application reliability was examined.

Moderate agreement was found with regards to levels of concordance and discordance.

The overall rate of over-triage (triageur assigning a higher acuity level than patient's actual acuity level) was in keeping with international standards and various other South African studies^{17;57;64;105;106}.

Under-triage (triageur assigning a lower acuity than patient's actual acuity level) was more than double the accepted international standard and other local studies^{17;57;64;105;106}.

The following were identified as potential contributing factors: Triage (TEWS) Scoring, patient acuity, patient load and level of qualification of the HCP performing the triage.

Question remains regarding the best tool to measure triage reliability as there is no gold standard.

Recommendations

Routine review and regular in-service training in the application of the SATS tool for medical and nursing staff.

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APPENDIX A: Human Research Ethics Committee clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

R14/49 Dr Deirdre A Hoffman

CLEARANCE CERTIFICATE

M111141

PROJECT

The Application Reliability of the South African
Triage Score in Adult Emergency Cases
Presenting to a Central Academic Hospital

INVESTIGATORS

Dr Deirdre A Hoffman.

DEPARTMENT

Division of Emergency Medicine

DATE CONSIDERED

25/11/2011

M1111410DECISION OF THE COMMITTEE*

Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE

20/01/2012

CHAIRPERSON


(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr Roger Dickerson

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX B: Permission letter

MEDICAL ADVISORY COMMITTEE
CHRIS HANI BARAGWANATH HOSPITAL
PERMISSION TO CONDUCT RESEARCH

Date: 26 January 2012

TITLE OF PROJECT: The application reliability of the South African Triage Score in adult emergency cases presenting to a central Academic Hospital

UNIVERSITY: Witwatersrand:

Principal Investigator: Dr D A Hoffman

Department: Emergency medicine

Supervisor (If relevant): Dr R Dickerson and Dr A Bentley

Permission Head Department (where research conducted): Yes

Date of start of proposed study: March 2012

Date of completion of data collection: March 2012

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Hospital. The CEO /management of Chris Hani Baragwanath Hospital is accordingly informed and the study is subject to:-

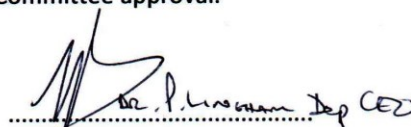
- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- the Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- the MAC will be informed of any serious adverse events as soon as they occur
- permission is granted for the duration of the Ethics Committee approval.



Recommended

(On behalf of the MAC)

Date: 26 January 2012



Approved/~~Not Approved~~

Hospital Management

Date: 30 Jan 2012

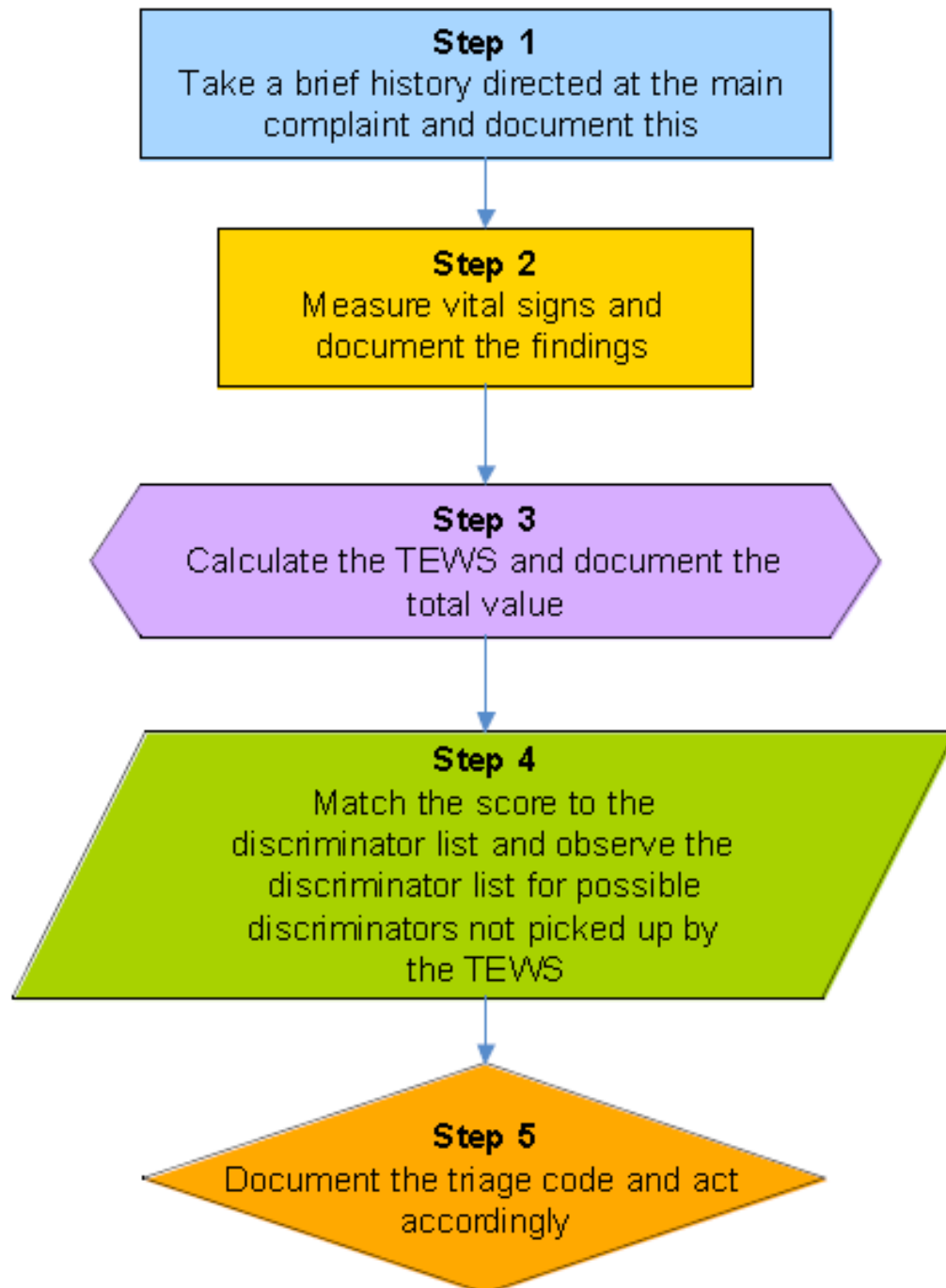
South African Triage Score



Protocol



FLOWCHART



ADULT TRIAGE SCORE

© South African Triage Group 2008

	3	2	1	0	1	2	3	
Mobility				Walking	With Help	Stretcher/ Immobile		Mobility
RR		less than 9		9-14	15-20	21-29	more than 29	RR
HR		less than 41	41-50	51-100	101-110	111-129	more than 129	HR
SBP	less than 71	71-80	81-100	101-199		more than 199		SBP
Temp		Cold OR Under 35		35-38.4		Hot OR Over 38.4		Temp
AVPU		Confused		<u>A</u> lert	Reacts to <u>V</u> oice	Reacts to <u>P</u> ain	<u>U</u> nresponsive	AVPU
Trauma				No	Yes			Trauma

over 12 years / taller than 150cm

Colour	RED	ORANGE	YELLOW	GREEN	BLUE
TEWS	7 or more	5-6	3-4	0-2	DEAD
Target time to treat	Immediate	less than 10 mins	less than 60 mins	less than 240 mins	DEAD
Mechanism of injury		High energy transfer			
Presentation		Shortness of breath - acute		ALL OTHER PATIENTS	
		Coughing blood			
		Chest pain			
		Haemorrhage - uncontrolled	Haemorrhage - controlled		
	Seizure - current	Seizure - post ictal			
		Focal neurology - acute			
		Level of consciousness reduced			
		Psychosis / Aggression			
		Threatened limb			
		Dislocation - other joint	Dislocation - finger or toe		
	Fracture - compound	Fracture - closed			
	Burn – face / inhalation	Burn over 20%	Burn - other		
		Burn - electrical			
		Burn - circumferential			
		Burn - chemical			
		Poisoning / Overdose	Abdominal pain		
	Hypoglycaemia - glucose less than 3	Diabetic - glucose over 11 & ketonuria	Diabetic - glucose over 17 (no ketonuria)		
		Vomiting - fresh blood	Vomiting - persistent		
		Pregnancy & abdominal trauma or pain	Pregnancy & trauma		
			Pregnancy & PV bleed		
Pain		Severe	Moderate	Mild	
	Senior Healthcare Professional's Discretion				

APPENDIX D: Chris Hani Baragwanath Academic Hospital Triage Form



Adult Triage

Emergency Department
Chris Hani Baragwanath Hospital

Date		Time	
------	--	------	--

Name	
------	--

Age		Gender	Male	Female
-----	--	--------	------	--------

Main Complaint	

Referral	Yes	No	From	Clinic	Private Doctor	Other Hospital
----------	-----	----	------	--------	----------------	----------------

Vitals	RR		BP		SpO ₂	
	HR		Temp		HGT	

		3	2	1	0	1	2	3
Mobility					Walking	With Help	Stretcher/Immobile	
RR		less than 9			9-14	15-20	21-29	more than 29
HR		less than 41	41-50		51-100	101-110	111-129	more than 129
SBP	less than 71	71-80	81-100		101-199		more than 199	
Temp		Cold OR Under 35			35-38.4		Hot OR Over 38.4	
AVPU		Confused			Alert	Reacts to Voice	Reacts to Pain	Unresponsive
Trauma					No	Yes		

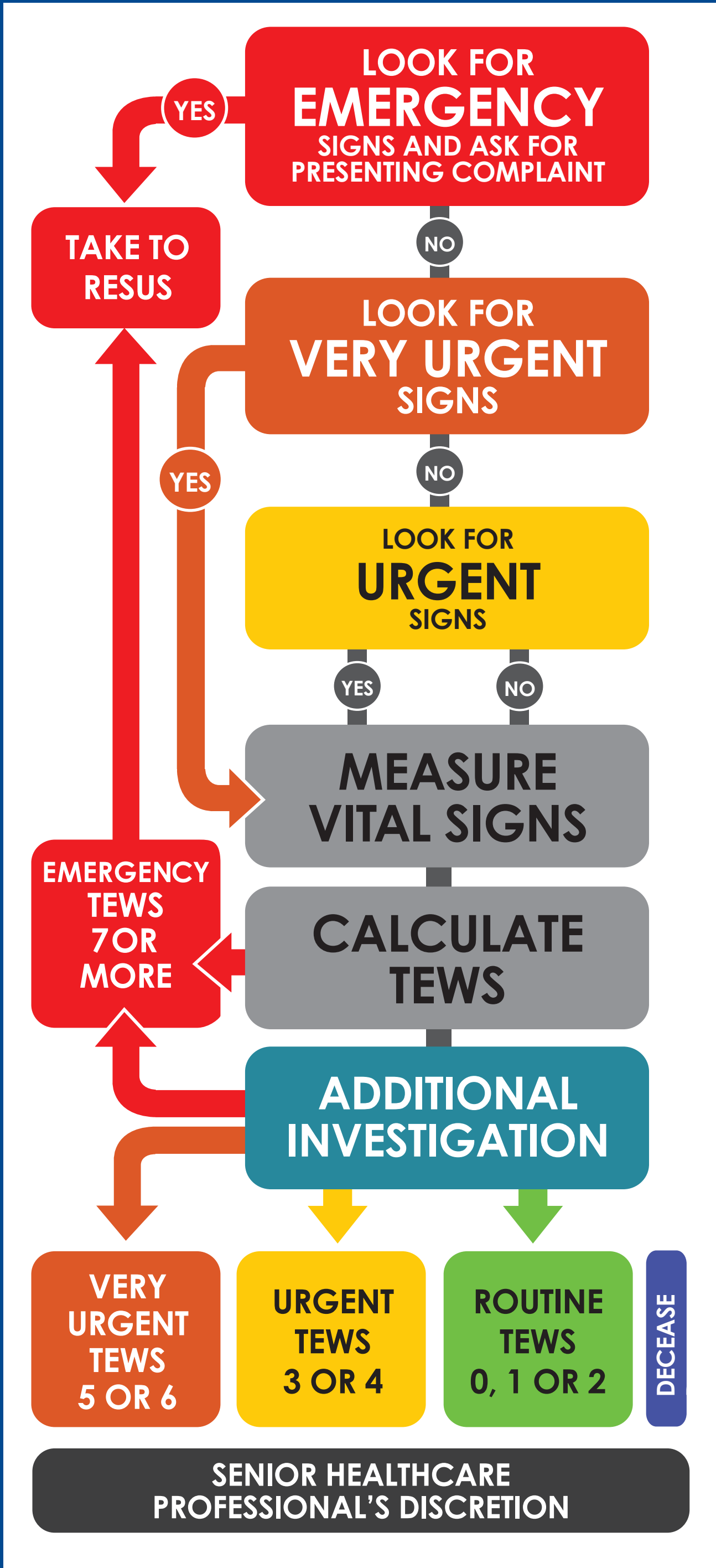
Circle

Triage Score		Triage Colour	
--------------	--	---------------	--

Plan	TRAUMA RESUS	MEDICAL RESUS	CUBICLES	CHAIRS	CHC	
					OPD	

Name		Signed	
------	--	--------	--

Adult SATS Chart



Western Cape
Government
Health

EMERGENCY

- Not breathing
- Seizure- current
- Burn - facial / inhalation
- Hypoglycaemia - glucose less than 3
- Cardiac arrest
- Obstructed Airway - Not breathing

VERY URGENT

- Level of consciousness reduced / confused
- High energy transfer (severe mechanism of injury)
- Shortness of breath - acute
- Coughing blood
- Chest pain
- Stabbed neck OR chest
- Haemorrhage - uncontrolled (arterial bleed)
- Seizure- post ictal
- Focal neurology - acute (stroke)
- Aggression
- Threatened limb
- Dislocation of larger joint (not finger or toe)
- Fracture - compound (with a break in skin)
- Burn over 20%
- Burn - electrical
- Burn - circumferential
- Burn - chemical
- Poisoning / Overdose
- Diabetic - glucose over 11 & ketonuria
- Vomiting fresh blood
- Pregnancy and abdominal trauma
- Pregnancy and abdominal pain
- Severe pain

URGENT

- Haemorrhage - controlled
- Dislocation of finger OR toe
- Fracture - closed (no break in skin)
- Burn - other
- Abdominal pain
- Diabetic- glucose over 17 (no ketonuria)
- Vomiting persistently
- Pregnancy and trauma
- Pregnancy and PV bleed
- Moderate pain

ADULT TEWS

	Older than 12 years / taller than 150 cm tall						
	3	2	1	0	1	2	3
Mobility				Walking	With Help	Stretcher/ Immobile	
RR		less than 9		9 - 14	15 - 20	21 - 29	more than 29
HR		less than 41	41 - 50	51 - 100	101 - 110	111 - 129	more than 129
SBP	Less than 71	71 - 80	81 - 100	101 - 199		more than 199	
Temp		Cold OR Under 35°		35° - 38.4°		Hot OR Over 38.4°	
AVPU		Confused		Alert	Reacts to Voice	Reacts to Pain	Unresponsive
Trauma				No	Yes		

CHECK FOR ADDITIONAL INVESTIGATIONS

If RR scores 1 point or more on TEWS	Check SpO ₂ and hand over to SHCP to give O ₂ Do a finger prick glucotest if patient is diabetic
Reduced level of consciousness (not alert including confused)	Do a finger prick glucotest and hand over to SHCP
Diabetes and Hyperglycaemia (glucotest 11 mmol/L or more)	Urine dipstick to check for ketones
Unable to sit up/ need to lie down	Do a finger prick glucotest and hand over to SHCP
Chest pain	Immediate ECG and hand over to SHCP Do a finger prick glucotest and hand over to SHCP IV access - NO intramuscular
Active seizure / fitting	Do a finger prick glucotest and hand over to SHCP
History of diabetes	Do a finger prick glucotest and hand over to SHCP
Hypoglycaemia (glucotest 3 mmol/L or less)	Move to resus hand over to SHCP and give something to eat or drink
Abdominal pain or backache: female	Urine dipsticks and Urine pregnancy test

APPENDIX F: Data Collection Sheet

DATA COLLECTION SHEET

DATA COLLECTION SHEET															
DAY OF THE WEEK:		TIME	Recorded Vital Signs							Triageur		Investigator		✓	x
Triage Form no. #	Triageur Qualification Level	Triage time of Day	RR	BP	SpO2	HR	Temp	HGT	Discriminators documented	Triageur Triage score assigned	Triageur Banding (Colour) assigned	Investigator Triage Score	Investigator Banding (Colour)	Concordant Triage	Discordant Triage
Total														Total	Total
Total daily no./load Triage Forms for specific day of the week:															
		DAY	NIGHT												

APPENDIX G: List of Trieur sample signatures

[illegible]

[illegible]

**** Please DO NOT write your name - only signatures required! ****

Sample Signature

Sample Signature

[illegible]

**** Please DO NOT write your name - only signatures required! ****

Sample Signature

Sample Signature

