



**The Burden of Trauma in a Regional Trauma Centre in the Western
Province of Saudi Arabia – A Descriptive Study.**

Mohammed Aasfi Patel

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Philosophy (Patient Safety) in the Faculty of Health Sciences at the
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Supervisor:

Professor Lee Wallis

Department of Emergency Medicine, Faculty of Health
Sciences, University of Cape Town, South Africa

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Abstract

Background and Objectives:

While trauma is currently the second leading cause of death in Saudi Arabia, little statistical information is available about injury rates and related patient outcomes. There is a need to understand trauma epidemiology to determine strategies that can be put in place to prevent and treat such trauma. We aimed to describe trauma rates, types of injuries, demographic distribution of injury and body regions affected by trauma in King Fahad Hospital in the city of Medina.

Methods:

The study was undertaken in King Fahad Hospital, the first multi-speciality reference hospital in the Medina region and the only trauma centre in the city. We collected retrospective data on all the trauma victims who visited the Emergency Department from 1st January to 31st December 2018. Simple descriptive statistics were calculated. Trauma mortality was compared with trauma scores with Receiver Operator Curves.

Results:

During the study period, 8793 patients were evaluated, 5846 (66.5%) males. The mean age was 27.5 years. 5608 (64%) were admitted in one of the in-hospital departments and rest were referred to OPD. Traffic-related injuries (4086; 46.5%) and falls (2993; 34%) were the most common causes of injury. Extremities injury (5929; 67.5%) was recorded as the most common body part. From the in-hospital patients, 5077 (90.5%) were discharged home and 167 (3%) died. Considering the mortality prediction accuracy of RTS and NTS. The RTS score of ≤ 9 had sensitivity and specificity of 90.2% and 90.4%, respectively, in predicting mortality in >5 -year-old patients. NTS score of ≤ 13 had 90% sensitivity and 97.3% specificity in predicting mortality in the age group of 0-5 year-old.

Conclusion:

This descriptive study is a crucial step in addressing the burden of trauma in Saudi Arabia. Information related to the characteristics of injuries and relevant patient outcomes may assist in further research into possible causal factors. It may contribute to the creation of new protocols in preventing and managing injuries more efficiently.

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PART A: LITERATURE REVIEW

A1: Introduction

This chapter investigates existing literature on the burden of traumatic injury with particular attention to types, mechanism, demographics, distribution, impact, outcome and prevention of trauma. Injury control and prevention in public health publications are generally referred to by the clinical term 'injury'.¹ In WHO reports, the terms 'trauma' and 'injury' are used with the same meaning. In this paper, 'trauma' and 'traumatic injury' will be used where relevant.²

A2: Objectives

In this literature review, the burden of trauma is elucidated from a national and global perspective, utilising the following categories:

- Global Burden of Trauma
- The burden of Trauma in Saudi Arabia
- Classification of Trauma (which describes the common types of injuries faced by the population)
- Economic burden of Trauma (through mortality and morbidity)
- Trauma care systems (structure and importance)

Findings from the available literature indicate possible gaps in knowledge relevant to the burden of trauma as conducted in High-income countries (HICs), especially in Saudi Arabia.

A3: Search Strategy

All relevant literature was included in the review, although it was limited to the English language. National Centre of Biotechnology Information (NCBI), Science Direct, Research Gate, Medline and Google Scholar were all databases searched to identify relevant published articles. Saudi specific publications were sourced through Annals of Saudi Medicine (ASM). Documents extracted through this method composed the core for this literature review. Where appropriate, all sources of literature were referenced.

The main objectives of this review provided keywords and phrases used for the search strategy.

- Burden of Trauma OR Injury Burden OR Injury OR Trauma
- In-hospital OR Emergency Department OR Casualty Room OR Trauma Care Systems
- Epidemiology OR Characteristics OR Features
- Revised Trauma Score OR New Trauma Score OR RTS OR NTS OR Outcome

Identified articles were further scanned for additional literature. To ensure the literature was relevant to current trauma trends and health care systems, search limiters were pre-established.

A4: Search criteria

- Related publications in the English language were included in this review.
- Publications related to pre-hospital emergency care, in-hospital emergency care, trauma care systems and trauma prevention were within the scope of this review.
- To meet current disease profiles and trends, only those articles published between 1998 and 2018 were included.
- All database material was used, which included reports, articles, reviews and publications.

Saudi-centric trauma publications reference lists were scrutinised to identify any additional publications. Abstracts of the publications were created during the searches, studied, and the full-text material was retrieved for the review.

A5: Summary of Literature

A5.1: Global burden of trauma

One-tenth of the world's burden of disease is accounted for by the ever-increasing public health problem of trauma. It far exceeds the total fatalities of tuberculosis, malaria and HIV/AIDS by approximately a factor of 1 to 1.7.³ Injuries are anticipated to have exceeded communicable diseases as the prime causes of disability-adjusted life years lost (DALY). It will be the prime cause of disability by 2020, according to Haider et al.⁴ Traffic accidents, according to the WHO, account for the deaths of 1.2 million people and a further 50 million suffer nonfatal injuries.⁵

There has been a marked improvement in the incidence of traffic fatality and morbidity in the past few years, particularly in developed countries such as the United States of America (USA).⁶ In 2013, compared to past four decades, there was a reduction of 25% in road traffic deaths.⁷ This gives a clear indication that injuries, particularly those resulting from motor incidents, are not 'accidents' as such but are events that could be predictable, preventable and treatable.⁸ This is of particular significance as many injuries are sustained by young people, leading to early death and lost years spent suffering a disability. A high percentage of disability-adjusted life years result from

injuries sustained through motor vehicle crashes (RTCs) 17.5%, falls 12.2%, violence 10.1% and suicidal injuries 9.7%.⁹

Motor vehicle occupants have a measure of protection, whereas motorcyclists are more exposed and have a greater vulnerability to injury or mortality.³⁸ Statistics verify this, where those involved in motorcycle accidents have a 35 times greater chance of death when involved in a crash, and are eight times more likely to suffer injury in comparison to a motor vehicle traveller.³⁹ Considering the age variations in traumatic injuries, Children are the most common victims of chest injuries caused by blunt trauma.⁴⁵ Children have a comparatively compressible thorax, whereby the ribcage is not fractured, but there is severe internal thoracic injury.⁴⁶ Subsequent haemorrhage is very life-threatening for children and when there are internal bleeding and thoracic injury, the likelihood of mortality rises from 5% for haemorrhage to 25%.⁴⁷

In this literature review, to cover all types of traumatic injury is difficult. Thus, exploring some common types of injury which can help in understanding the effect of trauma are reviewed in some detail, which is mentioned below.

Globally, traumatic spinal fractures (TSF) are a major consequence of traumatic injuries. They can result in permanent disability that has life-changing consequences on an individual's quality of life and seriously disturb that of their families¹⁰.

The annual figures show that TSFs afflict between 8 and 246 per million worldwide.¹¹ There is a higher mortality rate among adults than children resulting from traumatic spinal cord injury (TSCI).¹² Between the age of 16 and 29, the number of male sufferers exceed that of females and overall, the ratio is twice as many men as women suffer.¹³ Developed countries have the highest burden of severe TSCI cases. Statistics for the USA show that there is an annual incidence of TSCI of more than 50 cases per million population. The total number of new cases annually is 17,500, which is excluding the number of victims who die at the scene.¹⁴

European statistics show the estimated annual number of TSCI sufferers to be between 33 and 130.6 per million. In Canada, where the Canadian Spinal Cord Injury Rehabilitation Association conducted a systematic review, it was found that the annual figure for North America was around 17 to 83 per million inhabitants.¹⁵

Motor vehicle crashes are the largest single contributor to TSCI in the developed world. Again, taking the US as an example, the "National Spinal Cord Injury Statistical Centre" found that MVCs were the cause of 38.4% of TSCIs in the country. This accounts for the greatest number of spinal cord injuries, followed by accidental falls as a second cause (30.5%), thereafter, violence, and then sports and recreational activities had the next highest percentages with 13.5% and 8.9%, respectively.¹⁴

In contrast, a survey of 28 low- and middle-income countries (LMICs), using data from 64 documents, indicated that yearly occurrence of TSCI in those countries was 25.5 per 1,000,000 inhabitants. A far higher percentage of males than females, on a ratio of over 4 to 1, were likely to sustain TSCI injuries. The survey also deduced that MVCs were the prime cause of TSCI, showing 41.4%, followed by falls accounting for 34.9%.¹⁵

It is calculated that spinal cord injuries cost Australia approximately AUD 2 billion. It was suggested that the total long-term cost for a paraplegia sufferer was AUD 5 million and for a quadriplegia AUD 9 million.¹⁶ Annually, in the US there are some 10,000 incidents of TSCI. This is estimated to cost the country USD 8 billion.¹⁷

Accurate figures of TSCI in Saudi Arabia are not available because of lack of comprehensive information. Qatar, a similar but much smaller Gulf state, does provide TSCI data. They state their incidence rate as 12.5 per million and of this over 72% of the total is the result of road traffic accidents (RTCs).^{17,18} A general estimate of the incidence rate for the Middle East, including Jordan and Turkey, considers the annual rate to be 15 per million inhabitants. However, this is an estimate and could well fall far short of the real figure.¹⁹

The TSCI incidence was reviewed in a recent global epidemiological study for North America, where the rate was 40 per million, Western Europe, where the rate was 16 per million and Australia, where the rate was 15 per million. MVCs involving four-wheeled motor vehicles were the major cause of TSCI.²⁰

In comparison, the mortality rate in Saudi Arabia is very high as motor vehicles are the main form of transport.²¹ Statistics for 2007 show that over 7000 people died - in a population of 27.6 million - resulting from RTCs in that year, accounting for 41% of all deaths within the country.²²

In the majority of countries, the prime cause of morbidity and mortality results from traumatic brain injuries (TBIs). The age range most affected is those between 15 and 44.²³ The injuries can result in extreme disability both physical and cognitive and include personality changes, speech impediment and epilepsy.²⁴ This imposes a huge weight upon families, society and the health services in rehabilitation costs. There is an additional loss in productive years resulting from the death or secondary disability. In the US it is estimated to be USD 9.2 billion and USD 51.2 billion, respectively.²³

Figures are available for the incidence of head injury in the US during the first 5 years of 20th century. There were 1,700,000 reported cases annually, of which 1,400,000 were discharged from emergency departments, around 275,000 needed hospitalisation and were subsequently sent home after treatment, and about fifty two thousand patients proved to be fatal.²⁴ Similar statistics show that in Europe the

estimate of THI is 7,775,000 cases over 10 years, equating to 235 cases per 100,000 of the population.²⁵ The figures for Australia are 322 per 100,000 population.²⁶

Greater emphasis has been focused on the LMICs, highlighting that THI is one of the leading cause of disability and fatality.²⁷ As an example, in Al-Ain in the United Arab Emirates, 42 per 100,000 inhabitants suffered from THI, which accounted for two out of three trauma-induced deaths.²⁸ The THI incidence rate in Qatar was reported in a further study to total between 4.2 and 4.9 per 10,000 population.²⁹

In LMICs and high-income countries (HICs) the trauma incidents remains among the leading causes of death and long term morbidity.^{30,31} It has been calculated that annually above 5,000,000 people suffer premature death caused by traumatic injury, according to a WHO injury and violence report.³⁰ There is a critical need for action, worldwide, to abate the prediction that by 2030 trauma will be the fourth leading cause of morbidity and the fifth leading cause of mortality.^{30,31}

The rate of unintentional injury mortality due to falls is the second highest throughout the world⁹² and a proportion of 30-40% of hospital admissions for injury are related to falls, making the latter also the second-highest factor for hospitalisation associated with injury, regardless of patient age.⁹³ 10-15% of people attend the Emergency Department for reasons pertaining to falls.⁹⁴ Annually, over 37 million falls necessitate medical assistance and falls are responsible for the loss of more than 17 million disability-adjusted life years.⁹⁵ Being associated with high morbidity and mortality rates, unintentional falls have marked implications not only for the victims but also for their relatives and wider society.⁹⁶ Furthermore, such injuries are a massive economic burden on healthcare as they are expensive to treat. For instance, in the US alone, the management of falls cost more than \$50 billion in 2015.⁹⁷

According to WHO predictions, there will be a 100% rise in the burden of fall injuries by 2030 if no suitable mitigating measures are adopted.⁹⁸ Both population health and healthcare usage are impacted by fall injuries. Severe injuries are the consequence of about one-fifth of falls, with brain injury or hip fracture being amongst the injuries of greatest severity.⁹⁹ Meanwhile, around 50% of falls result in injuries of less serious, such as bruising, abrasions, lacerations, and sprains. There is research evidence that older individuals spend up to nine days more in the hospital due to falls compared to other causes for hospital admission.¹⁰⁰ Furthermore, by comparison to younger individuals, older patients have been associated with a mortality rate that is ten times higher for identical fall severity.¹⁰¹ Moreover, fall-related hip fracture, traumatic brain injury, and upper extremity injuries account for over 60% of hospital admissions for injury among older individuals.¹⁰²

Patients may sustain falls even during hospitalisation. According to a study by Rene S et al., 2-17% of hospitalised patients experienced falls, with the type of hospital and patient population being the factors determining variation in the rate of falls of between 1.4 and 17.9 per 1000 patient days.¹⁰³ Similarly, a different study reported that 23% of patients sustained falls during hospitalisation, causing bruises, sprains, and lacerations in 83% and fractures in around 9% of cases.¹⁰⁴

Worldwide, the burden of trauma is greatly increased by injuries to the body sustained during sports activities. According to the data, presented by McGuine T, the number of injuries arising from sports every year is 4 million, with emergency department attendance being necessary in around 2.6 million cases, which amounts to almost \$2 billion in economic terms.¹⁰⁵ Contact sports, in particular, have been reported to be the cause of over 50% of injuries, being associated with high injury and incidence rates, as indicated by a study of the incidence and type of sports injuries in Ireland.¹⁰⁶ Most injuries affected the lower extremities (e.g. knee, ankle, foot, toe). Ankle sprains were predominant, with possible causes including unawareness about the significance of adequate shoes and protective joint braces, especially as this type of injury occurs due to the stress related to excessive rotation and inversion or eversion.¹⁰⁷ Before-and-after exercise stretches are usually helpful for maintaining muscle flexibility, but one study observed that just 25% of sample athletes performed those exercises, which might reflect ignorance about fundamental measures to prevent sports injuries. Moreover, sports injuries may also arise due to extremely high levels of physical activity and insufficient recovery time.¹⁰⁸

A5.2: Trauma in Saudi Arabia

There have been major advancements in the health care systems of Saudi Arabia, generated by a massive investment over a relatively short period of time.^{32,33} As with many other LMICs countries, Saudi Arabia suffers a major burden of injury-related disability and death.^{34,35} Nationally, it is the second major reason of death, resulting in 20% of the country's reported fatalities.³⁶ The third cause of death is RTCs, resulted in 11.7% of all mortality.³⁷

There is a need for accurate details to establish public health planning and health administration for the incidence and prevalence of traumatic events in Saudi Arabia. Incidence rates help professional public health planners create suitable interventions and assist researchers in guiding them to prioritise studies. Accurate injury data are needed in Saudi Arabia to decide the suitability of current injury prevention strategies.⁴⁰ One important factor related to motorcycle accidents in the country is that they are

used almost solely for recreation, not as an essential means of transport and therefore the epidemiology and outcomes are likely to differ from those of other countries.⁴⁰

RTCs are a growing public health hazard in Saudi Arabia, where there were a major road construction programme underway and an attendant increase in the number of road users.⁴⁰ The increased rate of traumatic incidents is in proportion to this rise in motor vehicle numbers. There is a prominent rise in mortality rates in the past 30 years.⁴⁰ The figure is 4.7% of all mortalities, in comparison to 1.7% in Australia, England or America. This high figure is reflected in a statistical study that reports there are 12 road traffic deaths daily.⁴⁰

The traffic authorities state that MVC result from the following causes: speeding (43.11%), wrong turning of the automobile (14.69%), wrong way traffic (14.52%), improper vehicle stop (13.69%), not following the traffic lights (1.77%), and intoxicated drivers (0.01%); 12.21% were other causes.⁴¹

The level of RTCs in Saudi Arabia far exceeds that of other Arab states. It is six fold more than that in Algeria, a much densely populated country, and overall, in comparison to other Arab states, the Saudi Arabia death rate is higher.⁴¹ The country has undertaken a number of strict steps in an effort to decrease the number of crashes and road fatalities, with an aim to lower the total number of MVC fatalities by 30% during the next decade.⁴²

In Saudi Arabia, RTCs account for three-quarters of cases of hemiplegia, quadriplegia and paraplegia.⁴⁰ Head and face injuries cause 26% of deaths and comprise 30% of all injuries. The highest care and the longest hospitalisation relate to musculoskeletal and central nervous system injuries.⁴³ There is a particular injury, mostly suffered by children, the blunt abdominal trauma, where the commonest injured internal organs are almost always the liver and spleen.⁴⁴

Approximately a third of hospital deaths result from severe haemorrhage, an additional factor resulting in death, and is especially critical in multi-organ and head injuries. The prime cause of preventable deaths from trauma is caused by the delay in applying suitable early treatment through haemorrhage control in trauma victims.⁴⁸ Timely assessment of profuse haemorrhage, and, where appropriate, management is reported as being effective in reducing the mortality rate in bleeding trauma patients.⁴⁹ This public health situation calls for urgent action. The emphasis should be upon studying non-fatal outcomes as a guide to constructing trauma care systems. This is particularly relevant for Saudi Arabia, where the only data on the burden of trauma currently available relates to fatalities.

The burden of injuries sustained by the fall is also very common in Saudi Arabia. In 2015, the figures published by the MOH of Saudi Arabia indicated that emergency care

was required by trauma patients primarily due to falls ¹⁰⁹, while the recent data indicate that falls are associated with high morbidity and disability rates among older people.¹¹⁰ Standing and slipping were identified as the main fall mechanisms (52.6% and 23%, respectively) in a study undertaken in the Saudi city of Riyadh. On the whole, the injury of highest prevalence was limb fracture (73.3%), with fractures of the upper and lower extremities being more frequently sustained by children (44.5%) and older individuals (70.2%) respectively. Moreover, the rate of deaths as a result of fall injuries was 3.5% higher in elderly.¹¹¹

It is obvious that fall injuries have significant implications, yet they have not been extensively researched at a local level and even the existing studies have concentrated on falls sustained by older people or during hospitalisation, thus failing to provide a comprehensive picture of the issue.¹¹² One study reported that around 50% of older people sustained at least one fall in the past year, while a different study conducted in Riyadh in 2018, found that fall injury had been experienced by over half (57%) of individuals older than 60 years of age.¹¹³

Saudi Arabia has a high prevalence of injuries associated with sporting activities. The incidence, magnitude and seriousness of such injuries were investigated in a study undertaken in the Saudi city of Jeddah, revealing that soccer was the sport resulting in injury most frequently (50%), followed by basketball (34%), while swimming led to the injury in just 2% of cases.¹¹⁴ Furthermore, the greatest proportion of injuries (78.9%) were sustained by individuals practising sports leisurely, whilst professional and collegiate practitioners were associated with lower proportions of injuries (12.9% and 8.5%, respectively). Multiple injuries (3-4 times) were sustained in around 38% of cases.¹¹⁴ In terms of practice frequency, injuries were most prevalent among those with 2-4 hours of practice per week (62%), but least prevalent among those with 11-14 hours of practice per week. Moreover, injuries occurred in outdoor settings in almost half the cases (49%), with the knee being injured most often (46%), followed by the ankle (40%), and hands and fingers (27%). In over half of cases (56%), the injury occurred via twisting. The recovery time was 1-4 weeks in more than half the cases.¹¹⁴

A5.3: Classification of trauma

Traumatic injuries can be classified according to aetiology. The most common type of trauma aetiology is broadly grouped as “Unintentional injuries” and “Intentional injuries”.

A5.3.1: Unintentional injuries

Unintentional injuries resulted in almost 5 million deaths globally in 2004, according to a WHO report, in addition to over 138,000,000 disability-adjusted life-years (DALY).⁵⁰ They state that majority of these incidents occurred in LMICs. The largest proportion of unintentional injuries, one-third of the total, are caused by MVCs. The annual international incidence of unintentional injuries is 61 per 100, 000 population. The standardised per 100,000 population indicates that LMICs suffer almost twice the death rate of HICs (65 vs 35 per 100,000) and more than triples when examining DALY (2398 vs 774 per 100,000).⁵⁰

Promulgation of prevention and early intervention techniques on a worldwide basis has made a significant lowering in the burden of infectious diseases, and the public health issue of the increase in unintentional injuries has received growing attention. As previously stated, fatal incidents are contributed in small proportion to the epidemiology of traumatic injuries. The major part of the problem is the non-fatal health outcomes that ensue. Far more injuries lead to possible life-long disability, the likelihood of psychological trauma and attendant financial loss.

It is usual that young and healthy individuals who suffer injury. This results in many years lived with a disability. Of the children that are present to hospitals with unintentional injuries, 50% are left with residual disability, according to the WHO.⁵¹ Traffic-related injuries and fall account for the most unintentional injury-related causes of DALY lost per annum, at 17.5% and 12.2%, respectively.⁹

Usually, the countries with low evidence to direct management strategies, the least facility and the lowest level of health care facility to effect change are the ones with the highest-burden of injury.⁵² The global mortality burden is 6.6% annually. However, as most young people suffer injuries, there is a high ratio of disability to fatalities. This is in contrast to the situation amongst older populations where there are a higher number of deaths.⁵²

Unintentional injury deaths do not reveal the true impact. Non-fatal injuries, the true burden of unintentional injuries, can debilitate people for the remainder of their lives. It is reported that there were more than 138 million DALY in 2004.⁵² The most significant reason of unintentional injury are MVCs (33%), falls (11%) and drowning (10%).⁵²

It has been observed already that the financial hardship on victims, their relatives, the health care system and government, arising from injury is huge.⁵³ A report examining the yearly financial loss due to traffic-related incidents in more than twenty countries, conducted by the "Transport Research Laboratory", concluded that in LMICs it amounted to nearly 1% of gross domestic product (GDP), in HICs it totalled 1.5% and in highly motorised countries it accounted for 2%. The estimate for road traffic injury

costs worldwide was more than USD 518 billion, with over USD 65 billion accounted for in LMICs.⁵³

Most studies of unintentional injury costs have been commenced in HICs. In a USA study, the overall cost was assessed as USD 217 billion, with falls accounting for more than 40% of the total expense.⁵⁴ A further study of unintentional injuries of paediatric population estimated the cost to be USD 347 billion, equating to an annual cost of USD 17 thousand for each injured child.⁵⁵

There are five leading external causes of injury deaths in the USA, which account for 80% of all such deaths, consisting of three unintentional causes, RTCs, poisoning and falls, and two intentional causes, homicide and suicide, or violence-related causes.⁵⁶

A5.3.2: Intentional injuries

Globally, over 1,500,000 individuals die from intentional injuries annually, and many are disabled. The percentages vary according to the country but the generally accepted figure is that 90% of such incidents of homicide take place in LMICs.⁵⁷

In 2015, more than 1.4 million deaths resulted from intentional injuries totalling approximately 4% YLLs.⁵⁸ Hypothetically, intentional injuries can be avoided as they are the result of human action, whereas, most other injuries and diseases do not have the possibility of being controlled. However, statistics show that in 2015, 30% of all deaths worldwide were intentional, with suicide and homicide in the age group of 15 to 49 among the top 10 causes of death.⁵⁸

Saudi Arabia has been involved in a number of conflicts in its recent history, especially with the war in Yemen. This has resulted in major effects on intentional injuries. Conflicts and social unrest have obvious effects including collective violence and possible legal intervention, whereas information on acts of suicide, for example, are often suppressed on cultural and religious grounds.

In Tunisia, after the period of the Tunisian revolution in 2011, incidents of self-harm rose 1.7 times and homicide increased by three times.⁵⁹ In any form of society, young people's violence is the most serious issue. Street violence and incidents in school and in families have received wide publicity and in-depth studies. A major global burden of early death, injury and morbidity have resulted from homicide and non-fatal assaults carried out by the young.⁵⁹

An analysis of injury to young people resulting from violent behaviour found that, of the group questioned, 8% had suffered injury inflicted by non-family members, males more than females, 13.6% and 2.4%, respectively, and 2.2% of the group had suffered injury from family members. Motives were driven by male sex, drunkenness, aggressive

intentional harm seeking, group demonstrations and weapon carriers. It was noted that incident of suicide is predominant in compared to males.⁵⁹

In Asia, a study over a 12-month period found that 7.2% of students had felt unsafe at some stage, A study by Lee in 2007, discovered that 27.8% of students in Malaysian secondary schools participated in a physical fight, 6.6% had been injured fighting, and 5.9% possess weapons.⁶⁰

When investigating self-inflicted injury, the natural choice is to assess suicidal thoughts and attempts. Suicidal behaviour was assessed in a 12 to 17 age group in Hong Kong. The results showed that 3.4% of boys and 14.1% of girls had suicidal behaviour.⁶¹ A study of high school students in China found 19% had had suicidal thoughts and 7% had actually attempted suicide during the previous six months.⁶² A similar study by Chen in Malaysia among different racial and ethnic groups found that females had a rate of attempted suicide that was almost twice that males, 4.75 to 16% and 2.4 to 11.4%, respectively.⁶³

A Vietnam “Multi-Centre Injury Survey”, commenced in 2001, found that in young adults, the injury resulted in 70% of years of potential life lost, against 17% because of chronic medical illness and just 13% from communicable diseases.⁶⁴

Interpersonal, collective or self-directed violence lead to intentional or violent injuries. It is opined that violence is innate within us and has always been present throughout history. Its study needs to span from child maltreatment to elder abuse.⁶⁵ Morbidity and mortality resulting from an intentional injury are poorly recorded in most LMICs. The more common occurrence of injuries from RTCs receives greater attention.⁶⁵

The physical and psychological wellbeing of victims is threatened by intentional injury. In turn, they place a considerable financial and emotional burden on society and hospital resources.⁶⁶ Self-inflicted, interpersonal or collective violence resulted in approximate 1,600,000 fatalities worldwide in 2000. This equates to 28.8 per 100,000 population, overall.⁶⁷ They are amongst the ten leading causes of fatality in the 1 to 64 age group and one of the top 3 reason of death in the 10 to 34 age group.⁶⁸ The overall cost, direct and indirect, in the USA for gunshot, stabbing and cutting wounds is USD 177 billion, annually.⁶⁹ The circumstances that lead to violent injuries need to be considered when attempting to combat violence, followed by prompt treatment of the injured and rehabilitation of disabled victims.

A5.4: The economic burden of trauma

The normal method injury epidemiologists have employed in the past has been to rely on mortality data.⁷⁰ Since the introduction of the DALY, the concept of the burden of

disease has been increasingly accepted by countries and public health entities.⁷¹ The DALY considers the overall effect of disease burden; it calculates early death caused by a disease or injury and reflect it in Years of Life Lost (YLLs), and long term disability by the means of years lived with disability (YLDs).⁷²

The DALY is better suited for making health planning strategies as it offers a more comprehensive side of the relative gravity of different health problems.⁷³ The information obtained is vital for health care administration on prevention and control as it brings together collation of the health effects of numerous trauma and illnesses plus the relative risk factors across counties during the period.⁷³

That morbidity and mortality are caused by injury around the world has been substantiated by the WHO. It is calculated by fatalities, YLL, YLDs and DALYs.⁷⁴ Loss of health in terms of time is calculated by YLLs, YLDs and DALYs, where YLLs and YLDs make up the sum of the DALYs, RTCs were the main cause of DALYs for young males in 2010 (12.4%).⁷⁵

A global burden of disease study has established that years of potential life lost (YPLL) are attributable primarily to RTCs.⁷³ As an accepted public health measure, YPLL gives greater credence to deaths at a younger age, when individuals are considered to live with sound health for long.⁷⁶ A sum that equated, in 2015, to approximately 16.2% of the country's entire health service budget.⁷⁷ (183)

According to a study in 2013, it was estimated that 973 million suffered injuries that required some form of medical attention and 4,800,000 persons died from the injuries.⁷⁸ The prime reason of traumatic death were traffic injuries (29.1%), suicide (17.6%), falls (11.6%) and homicide (8.5%). Healthcare requirements of the injured amounted to 56.2 million (5.8%) requiring inpatient care, 21.7 million of who (38.5%) had suffered fractures. Outpatient care was rendered to 689 million (75.2%) who had suffered minor injuries.⁷⁸

Of the 2013 global burden of disease, 10.1% was the result of injuries. Collective violence (conflicts between nations) is a major issue in the proportion of DALYs resulting from disability (69.1%), falls account for 46.4% and forces of nature are attributable for 43%. Road injuries make the major contribution to injury DALYs (29.3%), followed by suicide (14%), falls (12.9 %), drowning (8.7%) and homicide (8.4%).⁷⁸

The attendant issues that require attention are the increased socioeconomic burden, the emotional and psychological stress placed upon families, the depletion of human resources and the over-stretch of healthcare facilities. These are all major factors that need consideration in detail when compiling preventive measure policies.

A5.5 Trauma care systems (structure and importance)

A trauma care system is an organised, all-encompassing and synchronised national injury response network, integrated with the public health care system, which incorporates all facilities and sectors able to provide injury care.⁷⁹ The elements of the system include those related to trauma prevention, pre-hospital and medical care, rehabilitation of the morbid, disaster mitigation and management, trauma life support training facilities with the ability to complete quality improvement. Importantly, it includes the involvement of society.⁷⁹

Human resources are diminished by trauma death as most victims are working individuals.⁸⁰ The supposition that suitably organised trauma systems result in improved mortality rates has been confirmed by studies in HICs.⁸¹ This has resulted from the implementation of organised trauma care programmes that bring together the pre-hospital and hospital phases of trauma care.^{2,82} The WHO Essential Trauma Care project is targeted at the disparities between HIC and LMICs outcomes and advocates the chain of trauma care.^{2,82} National or regional targets should be put in place with regard to the effective trauma care system implementation.⁸³ The trauma care system which attain these aims can be scheduled to allow gradual steps to be taken according to the local situation.

Essential components of a trauma care system

A number of elements of the trauma care system need to operate in unison to create a sound system that provides a safe and healthy environment for the community.

A5.5.1: The trauma advisory committee

The ideal organisation is to establish a trauma advisory committee (TAC) that draws up legislation, instigates policies and regulations, framework and implements the system, and maintains liaison between all sectors. The ultimate aim is to create a cohesive organisation that is able to work to develop injury prevention and monitor its operational efficiency.⁷⁹ Government backing should be available to the lead agency with an infrastructure that includes suitable office accommodation for the trauma system project manager, secretarial and administrative support staff, a conference room, database personnel and analysts, vigilance personnel and administrative staff, academic and statistician, together with any other resources required to make the system function efficiently.⁸³

A5.5.2: Legislation

Legislation comprises the rules and regulations established by the main agency.⁸³ It implements road safety regulation, all levels of essential regulation related to trauma care centre, together with their effective planning.⁷⁹

A5.5.3: System planning & finance

There should be the same mind set between members, all having a clear understanding of the objectives of the trauma system. They should cooperate to reach a common consensus on all issues.⁸⁴ The plan developed should involve all agencies and be founded on the evaluation of the requirements, the likely challenges, identified gaps and obstacles. It be accompanied by regular updates and reassessment and where necessary refinement of the planning.⁷⁹

There is a need for government and private funding to support this multi-faceted project, together with the prudent use of the resources available.⁸³ Funding can be supplemented by private companies dealing with distribution of the health care supply for system operation together with their contributions towards the maintenance of the lead agency, education and training programmes and other appropriate activities.⁷⁹

The costing can be departmentalised into three components of care: pre-hospital, hospital and rehabilitation. The costing can be calculated by taking the total number of annual injuries, whether they are major or minor, and the average cost per case. Training and recruitment costs need to be included in the budget.⁸⁵

A5.5.4: Injury prevention

The major consideration in the programme development is injury prevention.⁸⁶

Even with the best acute trauma care available, over 50% of deaths occur during minutes of the injury because of vital organ malfunction that is not recoverable. Injury prevention is the most practical approach in this instance.⁸⁷ High risk patients and patients with special challenge including co-morbid patients should be identified to affect preventative measures. Thereafter, strategies should be employed to improve personal behaviour by education and where necessary legislation to attain the best results from trauma prevention.⁸⁸

A5.5.5: Pre-hospital care

Pre-hospital care is a necessary provision at the scene, but there is a need for swift and safe transportation to suitable trauma care facilities to achieve better survival and outcome.⁸⁶ The urgency is evident from the 'golden hour' time-frame, which indicates

the urgency needed to deliver the injured patient to the definitive care at an appropriate hospital.

A5.5.6: Definitive care and rehabilitation

Evidence of improved fatality and disability results from injuries can be directly attributed to purpose-built trauma centres. Trauma systems are attributed to providing definitive quality care.⁸⁹ The centres should also be involved in the overall trauma system, including prevention, performance enhancement, maintaining the trauma registries, and have active participation in the trauma advisory committee. They should also have a mutual link with other regional hospitals for educational support and outreach.⁹⁰

Trauma centres can be subdivided into four categories, dependent mostly on the resources available, the level of expertise and the standard of care. There is likely to be a mix of levels of trauma centres within a trauma system. A Level One trauma centre will be a well-established definitive care facility with the ability to avail all required specialities and other healthcare professionals. There will be an in-house surgeon to attend to severe and complex injuries, with 24-hour availability of other medical and administrative staff and attendant ancillary services. It will be a frontrunner in advanced trauma care and will include quality improvement, continuous education and academic activities.⁹¹

The trauma system incorporates provision for the rehabilitation of morbid conditions from acute injuries as an important part of the system. The aim of rehabilitation intervention is to allow the regaining of normal physical and intellectual activities, where every effort is made to avoid any handicap.⁹¹ In addition to the above-mentioned trauma care components, human resources, education & training, information technology, quality evaluation and improvement and research are equally important to manage and run an effective trauma care system.⁹¹

A5.5.7: Review Summary

As discussed in above literatures, Traffic-related injuries and fall account for the most unintentional injury-related causes of DALY lost per annum, at more than 10% in LMICs each.⁹ Usually, the countries with poor resources and management strategies, and least available health care facility to effect change are the ones with the highest-burden of injury.⁵² As discussed by, Chandran A et al in their trauma epidemiology study, the global mortality burden is 6.6% annually. However, as most young people suffer injuries, there is a huge proportion of disability than fatalities, in most areas. Even, HICs are not spared with the consequences of avoidable injuries. As an

example, unintentional injuries make up 6% of total fatalities and over 12% of years of life lost (YLL) in Europe.⁵²

In a national statistics, conducted by Saudi Ministry of Health in Riyadh, pointed out that Saudi Arabia faces a huge burden of traumatic mortality and disability, it is the second major reason of death, resulting in almost 20% of the country's reported fatalities.³⁶ Considering this numbers and as discussed in the literature by Barrimah I et al. there is a need for evidence based details which can strengthen the public health planning and administration for the growing burden of traumatic events in Saudi Arabia. Relative statistics regarding trauma incidences help public health planners create suitable interventions and assist researchers in guiding them to prioritise studies. Accurate injury data are needed in Saudi Arabia to decide the suitability of current injury prevention strategies.⁴⁰

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PART B: MANUSCRIPT

This manuscript is prepared and formatted according to the Instruction to Author for the Saudi Journal of Medicine & Medical Sciences, included as an appendix.

The Burden of Trauma in a Regional Trauma Centre in Saudi Arabia – A Descriptive Study.

Patel Mohammed Aasfi¹, Professor Lee Wallis²

¹ Department of Emergency Medical Services, Al Ghad International Colleges of Applied Health, Medina Munawwarah, Saudi Arabia.

² Division of Emergency Medicine, Faculty of Health Sciences, University of Cape Town, South Africa.

Corresponding Author:

Patel Mohammed Aasfi
Department of Emergency Medical Services, Al Ghad International Colleges of Applied Health,
Medina Munawwarah, Saudi Arabia, 42313
Email: PTLMOH023@myuct.ac.za
Mobile: 00966599020739

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‡Manuscript word limit for Saudi Journal of Medicine & Medical Sciences is 3 000 words.

B1: Abstract

Background and Objectives:

Little statistical information is available about injury rates and related patient outcomes. There is a need to understand the type of trauma that patients experience to determine strategies that can be put in place to prevent and manage such injuries. The aim of this study was to describe the burden of trauma in the city of Medina.

Material & Methods:

The study was conducted in King Fahad Hospital, Medina. We collected retrospective data on all trauma patients who visited the Emergency Department from 1st January to 31st December 2018. Simple descriptive statistics were used to analyse the data. Trauma mortality was compared with trauma scores with Receiver Operator Curves.

Results:

Over the study period, 8793 patients were evaluated, 5846 (66.5%) males. 5608 (64%) were admitted to the hospital. Traffic-related injuries (4086; 46.5%) and falls (2993; 34%) were the common causes of injury. Extremities injury (5929; 67.5%) was recorded as the most common injury. The RTS score of ≤ 9 had sensitivity and specificity of 90.2% and 90.4%, respectively, in predicting mortality in >5-year-old patients. NTS score of ≤ 13 had 90% sensitivity and 97.3% specificity in the age group of 0-5.

Conclusion:

This descriptive study is a crucial step in addressing the burden of injuries in Saudi Arabia. Hopefully information related to the characteristics of injuries and relevant patient outcomes may assist in further research into possible causal factors. It may contribute to the creation of new protocols in preventing and managing injuries efficiently.

Key Words:

Burden of Trauma; Descriptive study; New Trauma Score; Revised Trauma Score; Saudi Arabia

B2: Introduction

Scant statistical information exists pertaining to trauma injury rate and associated patient outcomes, despite it being Saudi Arabia's second leading cause for mortality.¹ Indeed, internationally human health is posed with a marked risk from trauma, given that trauma-related injury is the cause of 9% of deaths around the world.² Injury or trauma is defined as a lesion to the body which is a result of physical injury from impact.³ Trauma can be minor, serious, potentially life-threatening or life-threatening.³ Road traffic collisions (RTCs), falls, homicide, suicide and burn are some of trauma's foremost causes. Significant morbidity and mortality rates are related to trauma, which internationally is deemed to be a serious public health issue.³

Data for July 2019 shows that Saudi Arabia's population exceeded 34 million people; the country is expansive and has a high income.⁴ Around six million cars are on Saudi Arabia's roads, and over the previous 10 years the RTC related mortality rate has increased significantly.⁵ In Australia and the UK, the present RTC related death rate does not exceed 1.7%, while in Saudi Arabia it is 4.7%.⁶ Disability of a permanent nature results from 7% of RTCs, while 20% of surgical beds are allotted to RTC victims, according to recent statistics.⁶

Globally, the burden of trauma impacts health care planners, policy makers, emergency care professionals, or patients themselves, one of their major confrontations is that of the burden of trauma.⁷ Literature has indicated that the burden of trauma is carried by populations worldwide to a disproportionate degree. The subject has had an extensive exposure over the past few years as a major public health problem worldwide and the indications are that over the next decade, the morbidity and mortality rates will grow.^{7,8} It is reported by the World Health Organization (WHO) that by 2030, globally, at all age levels, it will be the fifth major cause of death.⁷

Historically, the idea has been that injuries result from accidents, which are both unpredictable and inevitable. This viewpoint has changed over the past few years and the consideration now is that injuries, whether unintentional or intentional, are events that can be averted.⁹ This concept has placed the onus upon decision-makers worldwide to place greater awareness on injuries and resultant health issues. The public health arena has very much embraced the subject of injury policy.⁹ Understanding, gained over the past decade, that injuries are an avoidable public health problem has resulted in the establishment of preventative strategies, which in some countries has lowered the human death toll.⁹ Little data exist on this problem in Saudi Arabia. Thus, we aimed to add meaningful data on injury in Saudi Arabia.

B3: Material and Methods

B3.1: Study design

In this descriptive study, medical records of all trauma patients were reviewed retrospectively for twelve months in order to capture a realistic picture of the trauma burden in a calendar year and minimise potential seasonal differences in trauma incidences. All trauma patients who presented in Emergency Department (ED) of King Fahad Hospital (KFH) from 1st January 2018 to 31st December 2018 were reviewed. Patients from all age groups were included in this study. KFH is the first multi-speciality reference hospital in Medina region of Saudi Arabia.

In this retrospective review, data were extracted from the electronic databases of the hospital. The medical record department was consulted to ascertain missing variables through electronic discharge summary and patient's medical records. Patient age, gender, ethnicity, pattern of injuries, trauma mechanisms, disposition, and variables of revised trauma score (RTS) or new trauma score (NTS) were collected.

In KFH database, type of injury was coded by using International classification of diseases, tenth revision (ICD-10 code) and Mechanism of Injury was distributed by Abbreviated Injury Scale. Severity of trauma was defined by RTS and NTS scores. The RTS was calculated using Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR). NTS was ascertained by GCS, SBP, and peripheral oxygen saturation (SpO₂).¹⁰

To maintain methodological robustness in this retrospective chart review, Gilbert et al.'s recommendations were applied.¹¹

B3.2: Ethics

Ethical approval was obtained from the University Of Cape Town Faculty Of Health Sciences Human Research Ethics Committee (REF NO 623/2019). Research facility approval was granted by Institutional Review Board (IRB) of Madinah region under Saudi Ministry of Health (IRB 307, H-03-M-084) and Research Committee of King Fahad Hospital. As a retrospective chart review, active participation of the patient was not required. Thus, waiver of informed consent was sought.

B3.3: Statistical analysis

Data were extracted to Microsoft Excel from the KFH electronic database from where it was transferred into the 24th version of Statistical Package for Social Science (SPSS) programme, and MedCalc statistical software for the analysis.

Simple descriptive statistics were calculated. Means and standard deviations were calculated for continuous variables, whilst categorical variables are described by proportion and frequencies. We used RTS and NTS scores to evaluate mortality prediction ability of trauma patient. Receiver Operating Characteristic (ROC) Curve and Area under the Curve (AUC) were utilised for trauma scores. RTS score was determined for patients of five years or older. NTS score was utilized for children <5 years, because the physiological values to ascertain RTS score is not reliable in paediatric patients.¹² *P* value less than 0.05 and/or confidence intervals of 95% were considered significant.

B4: RESULTS

B4.1: Demographics

The study included all 8793 trauma patients, of which two-thirds were male (66.5%). The average age was 27.5 ± 19.4 (range 0-119) years (**Table 1**). More than 80% of the trauma cases were under 45 years of age. The age group of 16 to 30 was the most vulnerable, accounting for 30.1% of cases, and 6 to 15 year-old and 31 to 45 year-old each represented around 20% of cases.

Table 1: Patient distribution according to age and gender

		GENDER		
		Male	Female	Total
Age Group	<6	576	447	1023 (11.6%)
	6-15	1223	584	1807 (20.6%)
	16-30	2022	623	2645 (30.1%)
	31-45	1199	568	1767 (20.1%)
	46-60	475	382	857 (9.7%)
	>60	351	343	694 (7.9%)
	Total	5846 (66.5%)	2947 (33.5%)	8793 (100%)

Table 2 shows the trauma cases presented by ethnicity. The highest incidence was among local Saudi nationals (78.5%).

Table 2: Trauma patients according to Ethnicity

Ethnicity	Frequency	Percent
Saudi	6899	78.5
Asian	1059	12.0
African	670	7.6
American & European	31	0.4
Others	134	1.5
Total	8793	100

B4.2: Trauma distribution according to causes (mechanism of Injury)

Injuries sustained by trauma patients are shown in **Table 3**. Transport related injuries (RTCs, pedestrian and other transport injuries) accounted for 46.5% and falls for 34%: these were the two most common causes of injury. The cause of trauma was either missing or had been unspecified in 4.6% of cases in the KFH database.

Table 3: Causes and pattern of Injury

MOI	Head	Face	Neck	Thora x	Abdomen & Pelvis	Upper Extremities	Lower Extremities	Spine	External Causes	Unspecifi c	Total
Transport	954	144	55	187	172	1582	937	28	18	9	4086 (46.5%)
Fall	359	39	24	87	58	1293	1114	10	2	7	2993 (34%)
External Forces	59	4	0	5	0	37	464	0	28	5	602 (6.8%)
Self-Inflicted	12	0	2	4	2	17	9	0	0	1	47 (0.5%)
Violence & Abuse	40	2	0	7	5	25	133	0	1	4	217 (2.5%)
Burn	0	0	0	0	0	0	0	0	315	2	317 (3.6%)
Poisoning	0	0	0	0	0	0	0	0	127	0	127 (1.4%)
Unspecified & Missing	69	5	0	6	3	144	165	0	1	11	404 (4.6%)
Total	1493 (17%)	194 (2.2%)	81 (0.9%)	296 (3.4%)	240 (2.7%)	3098 (35.2%)	2822 (32.1%)	38 (0.4%)	492 (5.6%)	39 (0.4%)	8793

The upper extremities were the most commonly injured body region (35.2%), followed by the lower extremities (32.1%). Approximately 17% of cases resulted in head injuries, and 15% involved another body region.

B4.3: Trauma distribution according to ‘outcome (disposition)’

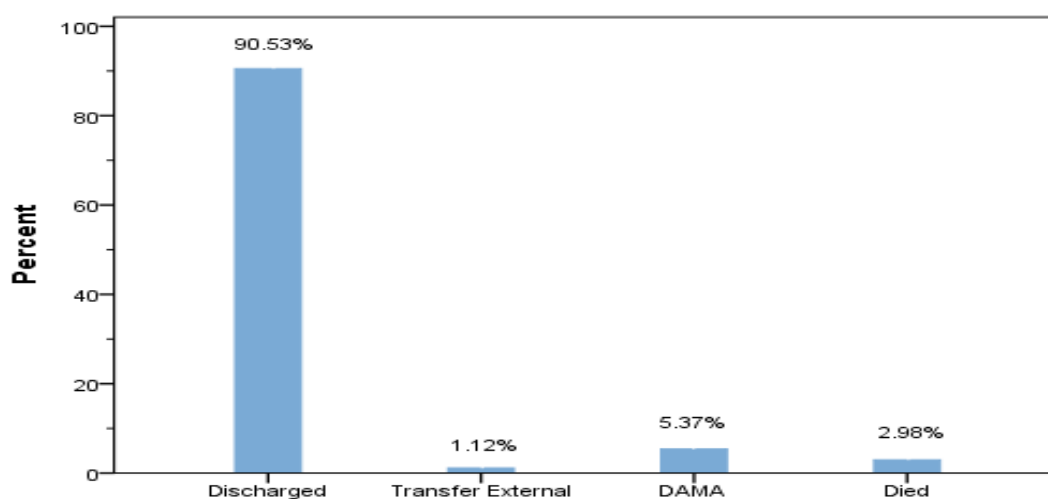
Over the study period, 8793 trauma patients were evaluated (Table 4). Of these, 5608 (64%) were treated inside the hospital departments, as in IPD and ED.

Table 4: Disposition of trauma patients from Emergency Department (ED)

Patient Disposition from ED	Cases	Percent
Treated in ED	3911	44.5
Treated in hospital (IPD)	1697	19.3
Referred to OPD	3185	36.2
Total	8793	100.0

The majority (90.5%) were discharged after treatment. A small number (5.4%), chose to discharge themselves against medical advice, and 1% were referred to another facility (figure 1).

Figure 1: Patients status at discharge



B4.4: Trauma mortality in KFH

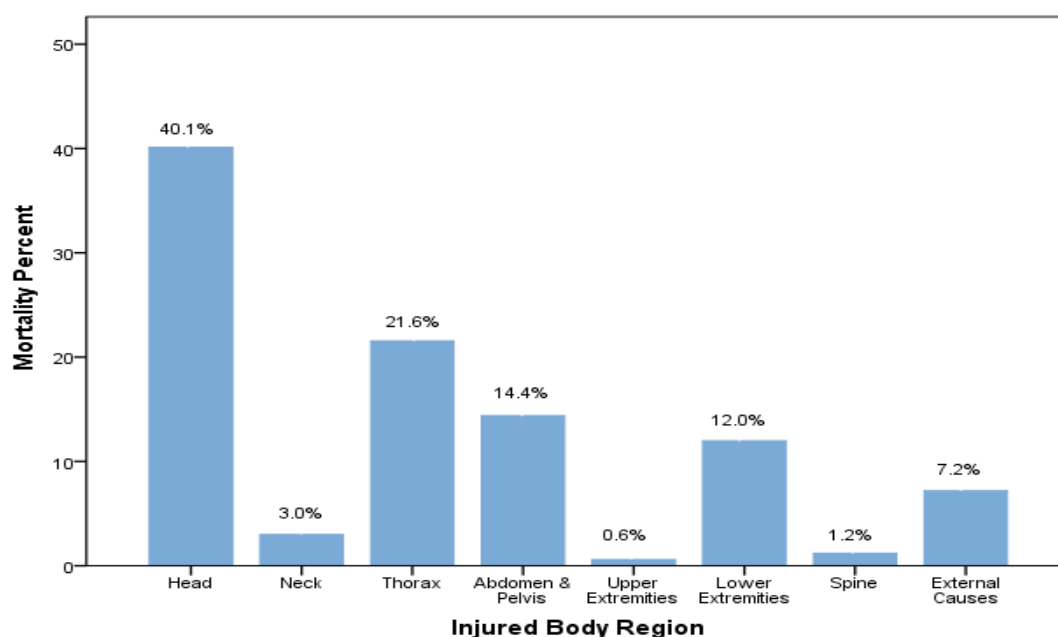
The mortality rate was 3% (167 cases). Transport related injuries were responsible for 63.5% of deaths (**Table 5**) followed by falls (24%). As demonstrated in **figure 2**, Patients with head injuries accounted for the highest mortality (40.1%) followed by thoracic trauma (21.6%) and Abdomen & Pelvic injuries (14.4%). Interestingly, the incident of trauma was highest in upper extremities, but resulted in only 0.6% of total fatality.

Table 5: Mortality and Mechanism of Injury

Mechanism of Injury	Case Mortality	Percent Mortality
RTCs*	59	35.3
Other Transport	7	4.2
Pedestrian	40	24.0
Fall	40	24.0
Inanimate Forces	3	1.8
Self-Inflicted	4	2.4
Violence & Abuse	3	1.8
Burn	10	6.0
Poisoning	1	0.6
Total	167	100.0

*RTCs = Road Traffic Collisions

Figure 2: Mortality distribution of trauma victims



*External Causes = Includes multiple regions or unspecified body area

B4.5: Trauma outcome and its comparison with Revised Trauma Score (RTS) and New Trauma Score (NTS)

We calculated Revised trauma score (RTS) and new trauma score (NTS) to compare trauma outcomes in the age groups >5 year-old and 0-5 year-old, respectively. Only 9.8% (n=477 of 4846) patients had RTS of ≤ 9 , but constituted the majority of mortality (83.9%).

Table 5: Mortality comparison with RTS (>5 years old patients)

RTS Cut-off	Outcome		Total
	Survival	Mortality	
RTS 9-12	4005	14	4019
	85.4%	9.0%	82.9%
RTS ≤ 9	347	130	477
	7.4%	83.9%	9.8%
NR*	339	11	350
	7.2%	7.1%	7.2%
Total	4691	155	4846
	100.0%	100.0%	100.0%

*NR (Not Reliable) = Patient under procedural sedation or on ventilator support or missing data.

The total number of patients admitted with an NTS of 14 or more was 680 (89.2%), with a mortality rate of 8.3% (n=1 of 12). 28 patients (1.3%) had an NTS of ≤13, and a mortality rate of 75% (n=9 of 12). In some instances, trauma score was not calculated due to unreliable or missing data: approximately 7.2% in >5 years-old category and 7.1% in patients of 0-5 years of age.

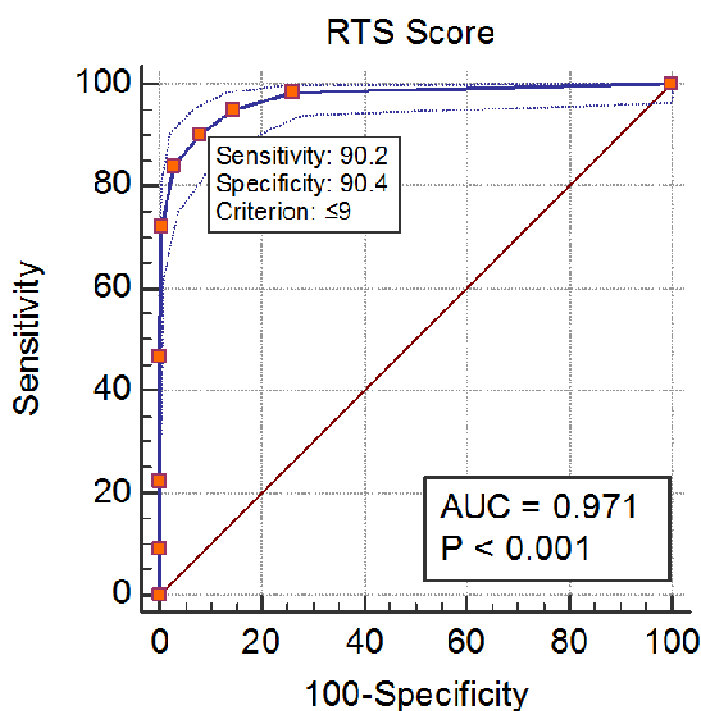
Table 6: Mortality comparison with NTS (0-5 years old patients)

NTS Cut-off	Outcome		Total
	Survival	Mortality	
NTS 14-23	679	1	680
	90.5%	8.3%	89.2%
NTS ≤13	19	9	28
	2.5%	75.0%	3.7%
NR*	52	2	54
	6.9%	16.7%	7.1%
Total	750	12	762
	100.0%	100.0%	100.0%

*NR (Not Reliable) = Patient under procedural sedation or on ventilator support or data is missing.

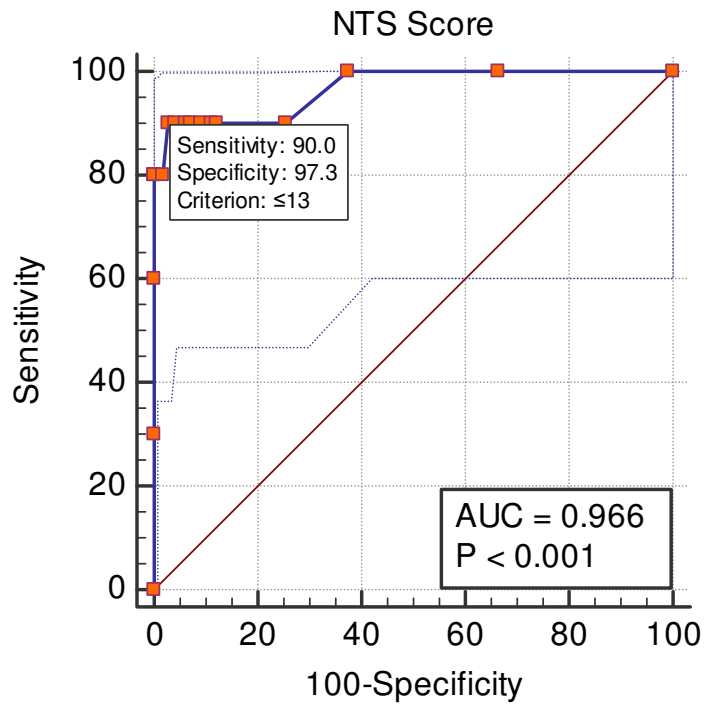
Considering the mortality prediction accuracy of RTS and NTS, a ROC curve was utilised (**figure 4 & 5**), which plots sensitivity against specificity. The AUC represents the accuracy of the test. The RTS score of ≤ 9 had sensitivity and specificity of 90.2% and 90.4%, respectively, in predicting mortality in >5 year-old patients (AUC 0.971 \pm 0.031, $P < 0.000.1$).

Figure 3: ROC curves of RTS in predicting trauma mortality in the age group of >5 years



NTS score of ≤ 13 had 90% sensitivity and 97.3% specificity, in predicting mortality in the age group 0-5 year-old (AUC 0.966 \pm 0.007, $P < 0.000.1$).

Figure 4: ROC curves of NTS in predicting trauma mortality in the age group of 0-5 years



B5: Discussion

Because trauma is a major public health problem in Saudi Arabia, there is a need for descriptive studies like this one. In accordance with other studies this research determined that the majority of those suffering trauma are men.^{13, 14} Men were found to suffer more injuries of a non-fatal and fatal nature (66%), reflected in our research. Given that until 2018 only men could drive in the country, this may be one reason for the higher injury rate.¹⁵ Furthermore, civil construction, infrastructure development, sports and other occupations posing greater risk are typically male dominated. Those aged 16 to 45 were the group seeing the highest incidence of injury. In the KFH, the most common cause of injury was RTC. The Saudi Ministry of Health data for the Medina region during 2018 corroborates the findings relating to substantial RTC injury.¹⁶ As data from neighbouring countries shows, Saudi Arabia's RTC injury prevalence was far greater than Iran¹⁷ (31.9%) and Oman¹⁸ (29.6%), although our results were similar to those in Pakistan (78.8%).¹⁹

RTC was the leading cause of mortality, accounting for 63.5% (106 of 167) in our study; this exceeds the rate in other national studies.²⁸ Falls were the second most common cause of death in KFH, responsible for 34% of all mortality. This proportion for falls should be deemed high in relation to other national studies.²⁹ Our results indicate that the extremities (67.3%) are the most commonly affected body part by the trauma. In accordance with other studies, head injuries (40.1%) were the commonest body part associated with mortality in KFH.³⁰ Furthermore, thoracic and abdominal injuries contributed considerably to mortality. In terms of the patient disposition, >90% of admitted trauma patients were discharged to home, while 3% died. Such a mortality rate is low compared with other regional trauma-1 centres¹⁵, although a recent study in Jazan indicated a mortality rate of 2.6%, even lower than our findings.²⁰

According to our study, violence and abuse accounted for just 2.5% of trauma, which is substantially below that reported in the majority of other countries, for example the United States of America and South Africa^{21, 22} A far greater amount of trauma cases are linked to stabbing or shooting incidents in the USA.²³ Many African countries and the USA have more liberal gun regulations in contrast with Saudi Arabia and its stringent laws, which may explain the difference. Unsurprisingly, self-inflicted injuries or suicidal incidents were only responsible for 0.5% of trauma injuries in our study, which is supported by other national studies.²⁴ Such injuries' reduced incidence is potentially due to two likely causes. First is Saudi Arabia's dominant religious beliefs, while second is underreporting as a consequence of societal values.

Mortality estimation through the Trauma Scoring system was appraised in our research. We utilized RTS and NTS to evaluate mortality prediction. RTS and NTS score are calculated using physiological variables. NTS score was utilized for children <5 years, because the physiological values to ascertain RTS score are not reliable in paediatric patients.²⁵ A mortality prediction tool is deemed to be effective when the AUC exceeds 0.8 during the ROC analysis.²⁶ Our study found a strong predictive ability for trauma mortality by RTS and NTS scores, with a 0.97 and 0.96 AUC respectively. Additionally, we found >90% sensitivity and specificity each in predicting mortality through RTS and NTS cut-off points of <9 and <13 respectively. A prospective study conducted in Kasr Al Ainy Hospital, Egypt demonstrated similar result to ours for RTS score, with the exception of higher cut-off RTS value.²⁷ They set RTS of <10 as a criterion. By establishing precise cut-off point of trauma score will help in identification of high risk patients. Thus, trauma patient can be managed by allocation of sufficient resources.

A number of limitations are identified in this study. One is that patient's records were used on for data in this retrospective research. The electronic database of KFH had a significant amount of missing or unspecified data. The moderate volume of missing values from the patient assessment findings (vital signs) in the KFH database made it difficult to ascertain the trauma severity assessment score. Therefore, we adopted basic trauma severity assessment tools such as RTS and NTS Scores. Those missing or unspecified values may be due to several reasons, for example language barriers between patients and families and their healthcare providers, particularly nurses, while filling in the data collection sheet.

Moreover, trauma patients' baseline assessment findings are sometime not conveyed to the ED staff properly, which may be a further reason. A second cause may be that regional medical facilities refer their patients to KFH, because the Medina region just has one level-1 trauma facility. The electronic database does not record the initial patient assessment information. Endotracheal intubation for respiratory assistance, for example, may have been provided to patients prior to referral to KFH, meaning that they have unreliable vital signs for trauma scoring.

The ability to generalize the findings of the research to the entire country is limited.

B6: Conclusion

This descriptive study has addressed the epidemiology of trauma in a level-1 trauma centre in the western province of Saudi Arabia. Trauma is a significant problem in Saudi Arabia. Injuries were predominantly caused by RTCs and fall. This study also

demonstrate the ability of RTS and NTS scores in predicting the related patient outcome accurately. Such data can help with health system planning.

B7: Acknowledgements

We would like to thank ED staff, IT department staff and medical record department staff of KFH hospital for their unconditional support during the data collection.

B8: Funding

This study did not receive any funding.

B9: Conflict of interest

The authors declare no conflicts of interest.

B10: References

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PART C: ADDENDA

C1: Appendix 1 Research Protocol

The Burden of Trauma in a Regional Trauma Centre in the Western Province of Saudi Arabia – A Descriptive Study.

MPhil candidate: Mohammed Aasfi Patel
Division of Emergency Medicine,
University of Cape Town,
South Africa.
PTLMOH023

Supervisor: Professor Lee Wallis
Division of Emergency Medicine,
University of Cape Town,
South Africa.

The study is in partial fulfilment of the Master of Philosophy: Emergency Medicine degree.

Declaration

I, Mohammed Aasfi Patel, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Date: 20 August 2019

Introduction

While trauma is currently the second leading cause of death in Saudi Arabia, little statistical information about injury rates and related patient outcomes is available¹. In fact, with 9% of deaths worldwide attributed to injury stemming from trauma, one can say that it constitutes a significant threat to human health across the globe². According to data from 2013, injuries (unintentional and intentional) represent the leading cause of Disability-adjusted life years (DALYs) and Years of life lost (YLL) in low- and middle-income countries (LMICs)³. Injury accounts for approximately 260 million DALYs lost and 220 million YLL, due to injuries alone³. Thus, injuries are responsible for over 20% of total DALYs and YLL in LMICs³.

Physical trauma or injury is defined as a wound or wounds to the body which is a result of physical injury from impact⁴. Trauma can be minor, serious, life-threatening or potentially life-threatening⁴. The most common causes of trauma include road traffic collisions (RTCs), falls, burns, drowning and suicide⁴. Trauma is considered to be a major public health problem around the world and is associated with high morbidity and mortality rates⁴. It is reported to be the leading cause of death, hospital admissions, as well as life-changing disabilities in the first 40 years of life⁵. The World Health Organization (WHO) has estimated that 5.8 million people die annually as a result of a traumatic injury, which accounts for 10% of all deaths around the world⁵.

Trauma in Saudi Arabia

Saudi Arabia is a large high-income country with a population of more than 34 million as of July 2019. It has been estimated that there are six million cars in Saudi Arabia, and there has been a sharp increase in the number of deaths associated with road traffic collisions (RTCs) over the last decade; the current mortality rate is 4.7%, compared to no more than 1.7% in countries such as the UK and Australia⁶. Recent data shows that RTC patients take 20% of surgical beds, and 7% of RTCs lead to permanent disability⁶.

The rise in RTCs over the last few decades has been associated with the oil boom in the country which has led to an increase in living conditions and to

significant changes in road networks and the number of cars on the road⁶. In the last two decades, many initiatives have been put in place including the legislation of seat belts and the introduction of speed cameras in larger cities to reduce trauma injuries associated with RTCs⁶. The large number of RTCs in Saudi Arabia has been attributed to a number of factors including violation of regulations, speeding and improper use of seat belts⁶. A recent study also found that although the citizens of Saudi Arabia are aware of the regulations, and have sufficient knowledge, they still do not follow the rules⁷. It seems to be a particular problem amongst young male adults, of whom 60% admitted to using their mobile phone when driving⁷. A recent study reported that RTCs are the most common trauma cause at the KFH¹¹. As the hospital serves pilgrims of the Hajj, the intake of trauma patients increases during the Hajj, with 713 patients being admitted to the emergency department and 248 to other surgical departments in a recent review¹².

Traumatic spinal cord injury (TSCI) is a major problem in Saudi Arabia, mainly arising from RTCs (85%), violence or self-harm (4.6%), falls (9%) and the remainder owed to sports injury⁹. A recent study reported that most of the TSCI patients showed tetraplegia which is common in patients who were not wearing a seat belt when in an RTC⁹. The severity of TSCI is often increased due to the lack of expertise when moving patients due to the lack of ambulances⁹.

According to Aldawood et al. (2012), traumatic head injury is the most common injury from an RTC and is also the leading cause of death amongst patients¹⁰. It has also been found that mortality rates are higher amongst older adults who have a head injury compared to younger patients¹⁰.

Motivation

The causes of trauma vary depending on location, due to variations in infrastructure, civil unrest and wars. If the causes of trauma can be understood, there is the chance to determine strategies which could be put in place in order to prevent such events.

Trauma management can be complex and is heavily dependent on the healthcare infrastructure within the local vicinity⁸. For example, the lack of

ambulances leads to delay in patients getting to the hospital, which can contribute to high mortality rates⁸.

This study will explore the trauma rates, types of injuries, demographic distribution of injury and body regions affected by the trauma in King Fahad Hospital in the city of Medina. Furthermore, the causes of such trauma will also be considered, and the systematic analysis of available data will determine the types of trauma injuries observed in the facility. Understanding the types of trauma experienced by patients will help not only to determine what strategies need to be put in place to reduce the incidence of trauma but also to ensure that the relevant expertise is present within hospitals to improve the long term outcome of such patients.

It is clear to see that trauma is a significant problem across the world, and is a major issue in Saudi Arabia. There is a need to understand the type of trauma that patients experience to determine which kind of strategies can be put in place to prevent and treat such injury. This study will aim to identify the main types of trauma, to inform such decisions.

Aim and Objectives

The aim of this study is to describe the injury patterns and clinical outcomes of trauma patients in King Fahad Hospital, Saudi Arabia.

In order to achieve the aim, the specific objectives of this study are as follows:

- 1) To quantify the trauma cases according to the "Injury Mechanism".
- 2) To describe the body regions affected by the trauma (patterns of injury).
- 3) To describe the demographic characteristics of trauma patients.
- 4) To describe the outcomes for injured patients on discharge.
- 5) To compare Revised Trauma Score (RTS) with patient outcomes.

Study Methodology

Study Design

This study will be descriptive, non-experimental and quantitative in design. Patient's data will be reviewed retrospectively for twelve months in order to capture a realistic picture of the trauma burden in a calendar year and minimise potential seasonal differences in trauma incidences. Data will be reviewed from 1st January 2018 to 31st December 2018.

Data of the patients will be collected from the hospital's registration system, patient's medical records, and medico-legal autopsies concerning patients who died of trauma-related injuries in the Emergency Department. The age and sex of patients, the location of injuries, trauma mechanisms, T-RTS scores, and radiological findings (such as fracture) will be collected in this study. Radiological findings from patients X-Ray investigation, Computerised Tomography (CT scan), Magnetic Resonance Imaging (MRI) and Focused Assessment Sonography of Trauma (FAST) will be recorded if available to ascertain the type of injury and affected body part. All relevant data are available in the patient's electronic records thus the data will be convenient to collect.

Sample Size and Setting

This study will be conducted in KFH, which is the first multi-speciality reference hospital in the Medina region. It has a 500-bed capacity. On average, KFH receives roughly around 600 – 800 trauma victims every month. KFH receives critical trauma patients from directly by Saudi Red Crescent Ambulances (SRCA) and other referred patients from local private and ministry run hospitals. Considering this, accurate sample size estimation is difficult, but, a study duration of 12 months should be able to amass a data set of around 7500 – 9500 trauma patients.

Inclusion Criteria

All patients who present to the emergency department of King Fahad Hospital with physical trauma or injury. Patients from all age groups will be included in this study.

Exclusion Criteria

All patients unrelated to trauma will be excluded from this study.

Retrospective Chart Review Methodology

Medical record reviews, alternatively referred to as retrospective chart reviews (RCR), denote a form of research wherein pre-recorded, patient focused data is employed to address one or multiple research questions¹³. The use of retrospective chart reviews is common throughout the field of healthcare, for example in epidemiological studies and descriptive research pertaining to specific health-related measurements or ailments¹⁴. Such research can yield valuable information, which can help to guide the direction of future research. Gilbert et al.'s work reviews the methodological robustness of RCRs in their sample and concluded that most studies were methodologically flawed¹⁵. As a result of this observation, the current study seeks a more rigorous approach for the RCR in order to eliminate any risk of potential mistakes in methodology.

1. *Abstractors training*

For the purposes of this research study, the primary researcher will obtain all relevant information from an electronic database and is familiar with the variables and their limits. Thus, no special training is required in this instance.

2. *Case selection criteria*

As regards the retrospective medical records review, evaluating a convenience sample during the course of twelve months should suffice and avoid the introduction of bias or inaccuracy. The inclusion and exclusion criteria are discussed in the section pertaining to methodology.

3. *Variable definition*

Variables are defined in the Data collection form, attached as appendix 2.

4. *Abstraction forms*

Predetermined variables are employed during data collection using a Microsoft Excel sheet on an electronic database. Data relating to all the

variables is chronicled in a simple electronically entered response section which permits convenient data collection. Thus, data standardisation significantly increases the internal validity and the extent to which a retrospective study is amenable to replication.

5. Performance monitored

Since the data is only gathered by the principal researcher, it becomes difficult to supervise performance during the data abstraction phase. However, the research supervisor is available for support and guidance and will be updated regularly throughout the abstraction stage.

6. Blind to hypothesis

This research is essentially descriptive. Consequently, it does not aim to test any relationship or to be experimental in nature. Moreover, there exists no hypothesis and there is no need for blinding.

7. Is Inter-Rater Reliability (IRR) mentioned?

Not applicable in this study.

8. IRR tested

The primary researcher will collect the data from a predefined electronic database. Thus testing IRR is not applicable in this study.

9. Are Medical Records identified?

Medical records will be identified through the electronic systems.

10. Sampling method

Relevant data of all trauma patients seen in the ED of KFH will be considered in this retrospective medical record review. The study duration will be one calendar year, starting from 1st January 2018 to 31st December 2018. During the entire study duration, medical records of the patients who met the inclusion criteria will be reviewed.

11. Missing-data management plan

In retrospective chart reviews it is crucial to maintain precise, reliable records of available and missing data. Thus, if missing data comprises under 5% of the total, it can be discounted as constituting any bias, particularly in large sample studies. However, if missing data comprises over 5% (> 5%) for each study variables, it is necessary to make a careful assessment to ensure that the absent items are not indicative of a pattern of bias ¹⁴. If data bias seems possible or the evaluation suggests a pattern or common theme, this should be presented for discussion to the study supervisor and addressed with a statistician.

12. Institutional review board (IRB) approval

IRB approval has provided by the regional committee of the Madinah region in Saudi Arabia (see appendix 1). Ethical approval will be sought from the University of Cape Town Human Research Ethics Committee once the research proposal obtains Emergency Medicine Departmental Research Committee approval.

Data safety and management

In order to maintain patient confidentiality, all data in the patient report is anonymised before extraction. It is then kept on a password-protected personal laptop to which only the researcher has access. All files are backed up on encrypted software.

Considering the study is a retrospective review of medical records, it can be categorised as a very low-risk study. Thus, any adverse events are unlikely to occur. If any safety event occurs, it will be immediately reported to the assigned supervisors, possibly within a day.

Data analysis

Data will be transferred to a Microsoft Excel spreadsheet from the KFH electronic database from where it will be transferred into the Statistical Package for Social Science (SPSS) programme for analysis.

Simple descriptive statistics will be used to analyse the data. Means and standard deviations will define the continuous variables, whilst the categorical variable will be defined by proportion and relative means. Correlational analysis (Inferential statistics) will be used to understand the extent of the relationship if any exists between mortality and Revised Trauma Score (RTS). Trends and occurrences observed will be illustrated in tables, graphs and histograms.

Ethical Considerations

Considering the nature of the study (retrospective and non-interventional), data collection permission from the Saudi Ministry of Health (MOH) and Ethics Committee of King Fahad Hospital (KFH) is sufficient to collect data from any governmental healthcare institute within Saudi Arabia. Internal research supervisor from the hospital is not mandatory in non-experimental retrospective studies. Emergency Patient Report (EPR) and Patient's hospital data are formal documents and property of MOH and KFH. Thus, the confidentiality of patient data and facility data will be maintained professionally; data will be stored in a password protected files and identified patient data would be anonymised by the process of encoding. Any information that could help in the identification of study subjects will be discarded as earliest as possible. In a RCR study like this, only existing data and records are collected for the analysis. Active involvement of sample population is not required. Thus, waiver of informed consent is sought for this study.

Reimbursement for research participants, emergency treatment, and insurance for research related problems are not required. To ensure the ethical and safe practices with research participant, co-investigator trained in "Protecting Human Research Participant" through an online course offered by National Institutes of Health in 2019 (copy is attached as appendix 3).

Resource Considerations

In this study, resources from the facilities (KFH) are limited to access the electronic clinical database. After obtaining ethical approval from the University

of Cape Town, King Fahad Hospital will be approached for the data collection. This research study is approved by the Ministry of Health of Madina region (IRB approval number 307) dated 13/05/2019. Copy is attached as appendix 1. There are no restrictions on the publication of this research study by the Saudi Ministry of Health.

Project Budget Consideration

Item	Description	Total Cost
1. Material and Supplies	NA	NA
2. Office supplies, printing & reproduction for data	Printing of institutional documents	R 500
3. Research travel	Travel to King Fahd Hospital by personal vehicle	R 200
4. Data Analysis	Statistician professional fees	R 2000
5. Editor	Language and editing	R 1000
Grand Total		R 3700

The primary researcher will bear all the study-related costs.

Project timeline

Activity (2019)	Jan-Feb	Mar-May	Jun-Aug	Sep-Oct	Nov	Dec - Feb
Proposal Development						
EM-DRC						
UCT HREC						
Facility Approval						
Data Collection						
Data Analysis						
Completion						
Submission						

Possible Outcomes

This study aims to offer a quantitative evaluation of the burden of trauma in one of the largest multi-speciality hospitals in the western province of Saudi Arabia.

It is to be hoped that information related to the characteristics of injuries and relevant patient outcomes may assist in further research into possible causal factors. It may contribute to the creation of new protocols in preventing and managing injuries more efficiently.

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Appendix 1

IRB Approval Letter (issued by the Ministry of Health, Madinah, Saudi Arabia)




وزارة الصحة
Ministry of Health

H-03-M-084

Institutional Review Board, General Directorate of Health Affairs in Madinah

To *DR. Mohammed Aasfi Patel*

This is to certify that Institutional Review Board (IRB), General Directorate of Health Affairs in Madinah has reviewed all the submitted updated and amended Documents from the ethical pointview and has approved your study titled: *"The Burden of Trauma in a Regional Trauma Centre in the Western Province of Saudi Arabia – A Descriptive Study."*

The committee is fully compliant with the conditions and principles of good clinical practice. The committee is constituted in accordance with the WHO and ICH-GCP guidelines and works according to written Standard operating Procedures.

The IRB recommended granting permission of approval to conduct the project along the following terms:

1. If there are any further amendments, they must be approved prior to implementation unless they are intended to reduce risk.
2. Monitoring: the project may be subject to an audit or any other form of monitoring by the REC.
3. All unanticipated or serious adverse events must be reported to the REC within 5 days or according to the protocol
4. Inform the IRB prior to making prospective changes to the study procedure
5. Upon the study completion, The PI is expected to submit a final report at the end of the study

Please note that this approval is valid for one year commencing from the date of this letter.


Head OF IRB Committee
Dr. Abdulhameed Alsubhi



IRB 307 ١٤٤١ هـ

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Appendix 2

Data Points to guide research data collection

A) Demographic Data

- i. Age (the age in months up to 12 months; or as whole years above that)
- ii. Sex (male or female)
- iii. Nationality (primary nationality as recorded in the hospital records)

B) Injury Data (Mechanism of Injury)

- i. Motor vehicle collision (mechanism was a collision involving 1 or more mechanical vehicles – it includes car, bus and truck)
- ii. Other transport-related injuries (collision involving motorcycle, bicycle, train, plane and boat etc.)
- iii. Pedestrian injury (injury to the walking person from any vehicle)
- iv. Fall (fall from height or fall from the same level)
- v. Thermal Burn (burn due to fire or flames)
- vi. Scald (burn due to hot liquids)
- vii. Drowning (submersion in any liquid)
- viii. Mechanical equipment (injury from any mechanical tool)
- ix. Poisoning (taking a substance that can be injurious to health)
- x. Homicide (injury purposely inflicted by another person)
- xi. Suicide (self-inflicted injury)
- xii. Bite Injury (bite by an animal, human or marine animal)
- xiii. Other/Unspecified

C) Injury Data (Parts of the body affected)

- i. Head/neck (injury to scalp, skull, intra or extra cranial structures and neck area)
- ii. Face (injury to face including eye ear, mouth, teeth, tongue and surrounding structures)
- iii. Extremity (injury to upper and lower extremities)

- iv. Chest (injury to anterior or posterior aspect of thorax excluding vertebrae & spine and intra thoracic cage)
- v. Abdomen (injury to anterior or posterior aspect of abdomen excluding vertebrae and spine, intra-abdominal organs)
- vi. Pelvis (injury to pelvic girdle structures)
- vii. Spine (injury to vertebral column and spine)
- viii. Multiple injuries (Injury to more than one region of the body)
- ix. Miscellaneous

D) Clinical Outcome Data

- i. Discharged from KFH
- ii. Under Treatment in KFH
- iii. Transferred to Other Health Care Facility
- iv. Left Against Medical Advice (LAMA)
- v. Died
- vi. Not Documented

E) Injury Severity Data (Revised Trauma Score)

- i. Glasgow Coma Scale (The GCS is used to describe the level of consciousness, it has three components: eye, verbal and motor responses. The three values are considered separately and summed. It ranges between 3 to 15)
- ii. Systolic Blood Pressure (SBP refers to the amount of pressure in the arteries during the contraction of heart, it ranges between 0 to >89 for RTS)
- iii. Respiratory Rate (RR is defined as the number of breaths per minute, it ranges between 0 to >29 for RTS)

Appendix 3

Protecting Human Research Participants Certificate



C2: Appendix 2 HREC Approval Letter



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone (021) 406 6525
Email: ghk@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

17 September 2019

HREC REF NO: 623/2019

Professor Lee Wallis
Division of Emergency Medicine
F51, Old Main Building,
Observatory
Cape Town, 7925

Dear Professor Lee Wallis

PROJECT TITLE: THE BURDEN OF TRAUMA IN A REGIONAL TRAUMA CENTRE IN THE WESTERN PROVINCE OF SAUDI ARABIA - A DESCRIPTIVE STUDY (MPHIL DEGREE - DR M A PATEL)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 September 2020.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

The HREC acknowledges that the student, *Dr M A Patel* will also be involved in this study.

Please also note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical

C3: Appendix 3 Facility Approval Letter



Hospital : King Fahad	Medina , KSA
Date 27 October 2019	IRB Approval Form

Institutional Review Board King Fahad Hospital – Medina

To :Mohammed Aasfi Patel

This is to certify that departure research committee King Fahad Hospital – medina al Munawarh has reviewed all submitted updated and amended documents from the ethical point of view your study (ADCARE) titled **The Burden of Trauma in a Regional Trauma Centre in the Western Province of Saudi Arabia – A Descriptive Study.**

All the updated documents received by the committee below have been reviewed and approved. The committee is fully compliant with the conditions and principles of good clinical practice , the committee is constituted in accordance with the WHO and ICH – GOP guidelines and works according to written standard operating procedures.

Below are the list of IRB members that reviewed and approved the above mentioned documents , kindly to know that only those IRB members who are independent of the investigator and sponsor vote / provide opinion on trial related matter:

Sc. No	Name	Role in Ethics Committee	Qualification	Attendance
1	Dr. Abeer Al- Harbi	Chairman	Consultant Chest & Sleep Medicine	Yes
2	Dr. Ghassan Al-Sisi	Member	Consultant General Medicine & Head of Dept	No
3	Dr. Ahmed Al- Hujaili	Member	Consultant anatomic pathology & nephropathology	Yes
4	Dr. Kawther Basher	Member	Consultant Internal medicine MRCP	No
5	Dr. Mafaten al- chaouli	Member	Patient safety director MD , M. Sc infection control	Yes
6	Dr. Fadwa Al- Oufi	Member	Consultant medicine & transplant infectious diseases	Yes

The REC recommended granting permission of approval to conduct the project along the following terms :

- 1- If there are any further amendments , they must be approved prior to implementation unless they are intended to reduce risk .
- 2- Monitoring : the project may be subject to an audit or any other form of monitoring by REC .
- 3- All unanticipated or serious adverse events must be reported to the REC within 5 days or according to the protocol
- 4- Inform the IRB prior to making prospective changes to the study procedure
- 5- Upon the study completion , the PI is expected to submit a final report at the end of the study .

Please note that this approval is valid for any year commencing from the date of this letter .

Head Of IRB Committee King Fahad Hospital
Consultant Chest/Sleep Medicine
King Fahad Hospital
Madinah - KSA



Medical Director
Dr. Badr Al- Homayeed

C4: Appendix 4 IRB Approval Letter



الاسم	جهة الإبتعاث	الدرجة	التخصص	السجل المدني
محمد أصفي باتيل	لا يوجد	ماجستير	طب الطوارئ	2301082638
عنوان البحث				
The burden of Trauma in a regional trauma center in the western province of Saudi Arabia				

سعادة / مدير عام مستشفى الملك فهد بالمدينة المنورة المحترم

السلام عليكم ورحمة الله وبركاته

نحيط سعادتك علما بأن الموضح هويته بعاليه قد استوفى كافة المستندات المطلوبة لإجراء البحث الخاص به وقد تمت مراجعتها من قبل إدارة البحوث والدراسات ولجنة أخلاقيات البحث العلمي بمنطقة المدينة المنورة برقم (IRB 307) وتاريخ 8-9-1440 هـ) وعلى ذلك تمت الموافقة على تسهيل إجراء البحث في المنشآت الصحية التابعة لمديرية الشؤون الصحية بمنطقة المدينة المنورة لذا:

نأمل من سعادتك بعد الاطلاع التكرم بتوجيه المختصين حيال تسهيل مهمته لجمع البيانات اللازمة بما يضمن ان لا يكون هناك أي تأثير على خدمة المراجعين خلال قيامه بمهام بحثه مع العلم بأن وزارة الصحة تضمن حقوقها في نتائج البحث من خلال اتفاقية المشاركة في البيانات والتي تم توقيعها بين الباحث وإدارة البحوث والدراسات بمنطقة المدينة المنورة.

ولسعادتك فائق تحياتي وتقديري.....

مدير إدارة البحوث والدراسات
بالشؤون الصحية بمنطقة المدينة المنورة
الدكتورة/ ياسمين طلال الجهني

* مع نيابة
تعتبر
مدير إدارة البحوث والدراسات
بالشؤون الصحية بمنطقة المدينة المنورة

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C5: Appendix 5 Instruction to Authors

Instructions to the Authors

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Saudi Journal of Medicine & Medical Sciences (SJMMs) is a peer-reviewed international journal published by **Imam Abdulrahman Bin Faisal University** (formerly University of Dammam), Dammam, Kingdom of Saudi Arabia. The journal's full text is available online at <http://www.sjmm.net>. The journal allows free access (Open Access) to its contents and permits authors to self-archive final accepted version of the articles on any OAI-compliant institutional/subject-based repository.

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A manuscript will be reviewed for possible publication with the understanding that it is being submitted to SJMMs alone at that point of time and has not been published anywhere or simultaneously submitted/accepted for publication elsewhere. One of the authors should be authorized to correspond with the Journal for all matters related to the manuscript.

All manuscripts submitted are duly acknowledged. All submitted manuscripts are checked for plagiarism using iThenticate and subsequently reviewed for their suitability for publication in SJMMs. Manuscripts with high plagiarism, insufficient originality, serious scientific or technical flaws and/or lack of a significant message are rejected at this stage along with manuscripts that are unlikely to be of interest to SJMMs readers. Suitable manuscripts are then sent to a minimum of two independent expert reviewers for assessing the scientific quality of the manuscript. The Journal follows a double-blind review process. The Editor-in-Chief, based on the comments and recommendations of reviewers, takes a final decision on the manuscript. The comments and suggestions (i.e., acceptance or rejection of or revisions in manuscript) received from reviewers are conveyed to the corresponding author. If a manuscript is requested to be revised, the author(s) is requested to provide a point-by-point response to reviewers' comments and submit a revised version of the manuscript. This process is repeated until reviewers and editors are satisfied with the manuscript.

Manuscripts accepted for publication are copyedited for language, grammar, punctuation, print style and format. Page proofs are sent to the corresponding author. The corresponding author is expected to return the corrected proofs within three days. It may not be possible to incorporate corrections received after that period. The entire process from submission of the manuscript to final decision and the subsequent sending and receiving proofs is completed online through the website <http://www.journalonweb.com/sjmm.net>.

Authorship Criteria

Authorship credit should be based only on substantial contributions to each of the three components mentioned below:

1. Concept and design of study or acquisition of data or analysis and interpretation of data;
2. Drafting the article or revising it critically for important intellectual content; and
3. Final approval of the version to be published. Participation solely in the acquisition of funding or the collection of data does not justify authorship. General supervision of the research group is not sufficient for authorship. Each contributor should have participated sufficiently in the work to take public responsibility for appropriate portions of the content of the manuscript. The order of naming the contributors should be based on the relative contribution of the contributor towards the study and writing the manuscript. Once submitted the order cannot be changed without written consent of all the contributors.

