

MAJOR INCIDENTS IN THE WESTERN CAPE, SOUTH AFRICA: A DESCRIPTIVE STUDY

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PART A

LITERATURE REVIEW

Introduction

The tsunami of 26 December, 2004 will long be remembered for the number of deaths that it caused (over 250,000). Although this single incident contributed to the total of four times the number of deaths from disaster in comparison with previous years ¹, the total number of people affected by such events each year is many times higher. Disasters and mass casualty situations are becoming more frequent, and are affecting more people¹ 254 million people were affected by disaster in 2003 ¹, and in 2004 there were 97 major floods recorded, along with 75 wind storms (hurricanes) and 28 earthquakes, causing a total of \$88 billion in damages ¹.

Whilst a disaster is typically thought of as a naturally occurring event (such as an earthquake or tidal wave), a mass casualty situation may occur from a natural or man-made source (such as a mass transportation collision, or industrial fire). In many higher income countries, mass casualty situations tend to be referred to as Major Incidents. Although a standard understanding of what constitutes a major incident has not been agreed, with the term being interchanged with both mass casualty incident and disaster, for health services a major incident may be considered to be:

“any occurrence which presents a serious threat to the health of the community, disruption to the service or causes (or is likely to cause) such numbers or types of casualties as to require special arrangements to be implemented by hospitals, ambulance services or health authorities” ².

(Major incidents for services other than the Emergency Medical Services (EMS) will not affect health providers, and so are not considered in any more detail here.)

This definition is intentionally broad, to cover incidents from food poisoning outbreaks to planning for mass gatherings. However, major incidents are generally regarded as events which are unpredictable, sudden and which result in a large number of injured or ill casualties presenting to the emergency services over a short period of time.

The alternative term used is Mass Casualty Incidents (MCI) , loosely described as “the most demanding and chaotic events a responder will ever be confronted with”, the ultimate goal being to get the greatest number of survivable patients to treatment facilities in the shortest amount of time.³

The point at which a major incident occurs is dependent upon the ability of health service resources at the time of the incident to cope with the patient workload ⁴. Major incidents may therefore occur with relatively small numbers of casualties if resources are scarce: this is particularly likely to occur in low and middle income countries where healthcare resources are limited at the best of times. The health services definition also takes into account the severity of injury, as an incident resulting in a small number of casualties may require a major incident response if they are all severely injured.

Currently there does not exist a form of quality measurement for evaluation of a response to a major incident but emergency services aim for an early activation of sufficient personnel, rapid access to a secured scene and efficient patient evacuation to the correct facility.

In the Western Cape a major incident is declared at the discretion of the most senior Emergency Medical Services (EMS) staff who are present at the scene. Usually this includes: where the resources used are more than 2 ambulances, other agencies are involved (Fire and Rescue) or 3 or more patients, ⁵ most commonly though the MIMMS definition is used “ any incident where the location, number, severity or type of live casualties requires extraordinary resources” ⁵

Table 1

High Profile Major Incidents in Cape Town

Date of Incident	Type of Incident	Mortality/Morbidity
May 2014 ⁶	Shack fires, Masiphumele informal settlement	1 dead, 1000 homeless
November 2012 ⁷	Collapse of free standing structure at music concert (8)	1 death/ 12 hospitalization
January 2013 ⁸	Shack fire in Khayelitsha informal settlement	120 shacks destroyed/ 200 left homeless
May 2010 ⁹	Bus accident at De Doorns	24 dead / 55 injuries

International Major Incidents

International studies of major incidents either focus on describing a single type of incident eg: Hurricane Katrina or reported major incidents over a period of time by Corley et al ¹⁰, who have a database which collected major incident data over a 28 year period in the United Kingdom (UK). The analysis included 3-4 major incidents per year (range 0 to 11) – although this is likely to be an underestimation, smaller incidents being public transport and larger incidents included civil disturbance and industrial accidents.

These typically produce injuries rather than ill patients ¹¹.

A University of Glasgow guideline for major incidence response highlights that the main types of incidents are stadia, civil disorder, transport and industrial. They concluded that the majority of incidents results in fewer than 100 casualties. ¹² The experience base of the UK in major incidents is largely based on terrorist events from local groups, historically IRA and 2007 Tube bombings. A strong point made in all these studies is that communication failure is the most common disaster response problem delaying action and treatment.

A comparative study completed in the Middle East (Saudi Arabia) in 2009 has similarities to South Africa in that they too are a developing country and the challenges are unique in terms of training, distances covered, staff availability and standards of facilities when it comes to coping with a major incident.¹³

Besides some significant natural disasters in the USA (mainly tornadoes and hurricanes) 2013 had few significant major incidents since 1994.¹⁴ they do though have a recent history of school shootings which mostly fit the classification of major incidents. December 14 2012 saw 27 dead at Sandy Hook Elementary school, Connecticut.

Preparation for these events is difficult and wrought with political issues. Prevention in this instance is the key. This is one of the few major incidents which on a higher level can be controlled and avoided.

One of the most recent major incidents in Japan that was the Tohoku earthquake causing a tsunami which hit the Fukushima nuclear power plant on 11 March 2011.¹⁵ Notably no deaths followed short term radiation exposure but 16 000 people died as a result of the earthquake and tsunami.

The enquiry that followed was scathing in that it stated the nuclear disaster was “man-made” and that its direct causes were all foreseeable. The report also found that the plant was not able to withstand the effects of the earthquake and tsunami. The Nuclear and Industrial Safety Agency (NISA) found there was not proper planning or preparation for containing collateral damage for such a disaster or the development of evacuation plans.¹⁵

A 2008 in-house study identified an immediate need to better protect the facility from flooding by seawater, it mentioned the possibility of tsunami waves up to 10 metres high. Headquarter officials insisted that such a risk was unrealistic and dismissed the study.

In high income countries, major incidents remain relatively rare, although increasing media news presence may give the perception of a high incidence: several high profile incidents have added to this perception in recent years, as shown in Table 1.

Table 2 Examples of recent International High Profile Major Incidents

DATE	LOCATION	TYPE	CASUALTIES
July 2013 ¹⁶	Spain	Train derailment	80 dead, 140 injured
July 2012 ¹⁷	Colorado, USA	Cinema Shooting	12 dead, 71 injured
July 2011 ¹⁸	Oslo & Utoya Island, Norway	Explosion & Shooting	77 dead, 319 injured
March 2011 ¹⁹	Oshus, Japan	Tsunami	15 889 dead, 6152 injured

In the African setting, there is some evidence that the incidence of major incidents is increasing, probably due to increased urbanisation.²⁰

Preparation and Planning

Preparation has shown to reduce morbidity and mortality in major incidents, weak points in major incidents preparation that have been identified are: Human resources (staffing and training), physical resources (equipment, supplies and infrastructure), administration and organization.^{21 22} Based on the experiences of the South African team who responded to the Haiti earthquake in 2010 many of the lessons learned can be extrapolated to the Western Cape disaster preparedness. Problems that were encountered were mainly related to logistical issues with relation to the actual deployment of the doctors and the cost involved for three days of relief work. Preparedness and training for disasters/search and rescue is being prepared by INSARAG, and the feeling is that attendance of this course should be a pre-requisite for any volunteer who would be involved in disaster relief and search and rescue work.²³

Teaching and planning have been emphasized in a Scandinavian study²⁴. They highlight that an effective disaster response depends on a structured response between agencies and good communication. The presence of regional medical operational centres has shown to reduce mortality in disasters. They conclude that disasters are inevitable but with data

accumulation, planning, research and practice they can be managed appropriately with minimal mortality and morbidity. This was all shown to be correct in the shootings in Utoya and bomb blasts in Oslo, Norway. Poor planning included inability for the police to reach the island after being informed of the 1st shot within 1 minute of being fired but only reaching the island after 63 minutes.²⁵

Hurricane Katrina, besides the human cost to life and the financial cost to the United States of America (USA) has brought about many positive changes to disaster preparedness. FEMA offers a course, Integrated Emergency Management Course (IEMC). It is a four day course which focuses preparedness and response in emergency situations resulting from a hurricane. The target audience includes EMS staff/Health Care Providers but also public officials such as Mayors and County Managers.²⁶

Other UK studies highlight the preparation for and review of management of major incidents in the past and how they are able to improve on the performance of the various medical systems²⁷

Training in the Western Cape in preparation for future major incidents and the Soccer World Cup 2010 was achieved by the MIMMS/HMIMMS and weeklong Disaster Medicine Course run by the Joint Division Emergency Medicine at Stellenbosch University (SU) and University of Cape Town (UCT).

This descriptive study from a database helps in part to identify any deficiencies in the current system in the Western Cape EMS and Major Incident planning.

Responding to major incidents

Response systems are addressed in different ways across the globe, but the main separation appears to be between the United States and other high-income countries. The main system adopted across USA is the Incident Command System (ICS);²⁸ the United Kingdom, much of Europe and the Middle East, Australia and recently South Africa have adopted the Major Incident Medical Management and Support (MIMMS)²⁹ system. While the ultimate end aim is the same in both, the approach is significantly different. As ICS assumes significant infrastructure and resources, whilst MIMMS uses principles that can be applied in any

resource setting (and has been adapted in South Africa), ICS will not be considered further here.

MIMMS uses a 'CSCATTT' approach to the management of a Major Incident:



These priorities followed in turn aim to allow for the successful management of an incident, and are each logical in their own purpose. Highlighting their importance, a significant amount of the recommendations to come following the 7th July 2005 terrorist attacks in London were related to the principles of Command-Safety-Communication.^{30 31}

In what is likely to be a chaotic situation, a clear and direct Command is essential. Most Major Incident plans will have a nominated organisation, such as the Police Service, to take overall responsibility for an incident. As this is a pre-determined action, it removes the potential for ambiguity at the scene.

The safety of the Emergency Services at a Major Incident is paramount, in order to prevent further casualties and distract from the main aim. Safety in this sense encompasses several things, ranging from the safety of the incident in question, to the suitability of an individual's Personal Protective Equipment. All of the incidents created a hazardous environment for those working within it. With terrorist incidents, consideration must be given to the potential for further attacks, which may cause further harm and indeed where the Emergency Services themselves may be targeted directly.³²

Communication is the third key step in the effective management of a Major Incident. Described by the London Resilience Forum as being "communication within and between the emergency, health, transport and other services. It also includes effective

communication with individuals caught up in the incident, and the public at large”³³.

Reports from major incident inquests regularly cite communication as the single greatest failing in response.

Scene assessment is conducted once the first three priorities have been established. Major incidents are dynamic situations, and the assessment only provides information that is available at that point in time.

Triage and Sorting

Triage is one of the most important tools in major incidents for on-scene management. It is derived from the French word “trier” : to sort or sieve. It has military origins where the chaos on the battlefield and severity of wounded soldiers needed quick decisions as to who to evacuate and who should stay, including those soldiers who were peri-mortem. Triage is aptly described : “Human nature is to pay attention to the person who is screaming and bleeding but someone else with a less obvious internal injury may need to be the first priority” (triage from a distance) Triage is noted to be a dynamic process, as the patient’s condition changes so does the colour coding and level of intervention.

Napoleon’s Surgeon, Baron Dominique Jean Larre, conceived the concept around 1792. “Those who are dangerously wounded should receive the first attention, without regard to rank or distinction.”³⁴ It is a key tool in major incident management, to help ensure that the response does “the most for the most”(ALSG). There are some subtle variations in triage categorisation, but the MIMMS system uses:

- Red: (P1) Immediate
- Yellow:(P2) Urgent
- Green: (P3) Delayed
- Blue: Deceased

The tools used to categorise patients within the MIMMS system are the Triage Sieve (fig 1) and Triage Sort (fig 2). The Sieve is a primary field triage tool constructed to prioritize patients for evacuation to more advanced scene care. It is based on assessment of the ability to walk, airway patency, respiratory and heart rate. At the site of more advanced care (on scene or at the hospital), the Sort refines the priority. It is physiologically based but combined with an assessment of likely injuries³⁵. Speed, accuracy and reproducibility are the fundamentals of triage.

Figure 1: Triage Sieve

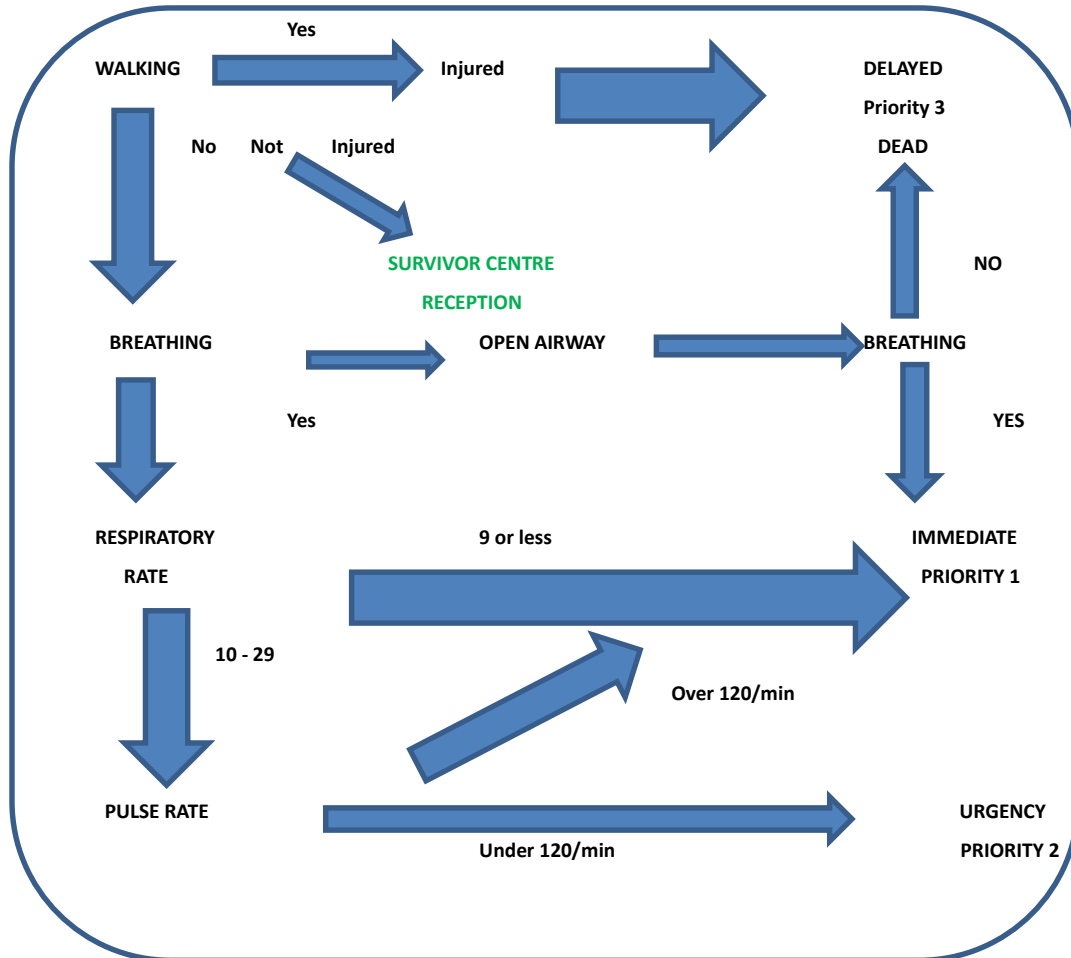


Figure 2: Triage Sort

Step 1: Calculate the GLASCOW COMA SCORE (GCS)					
A: Eye Opening		B: Verbal Response		C: Motor Response	
Spontaneous	4	Orientated	5	Obeys commands	6
To voice	3	confused	4	Localises	5
To pain	2	inappropriate	3	Pain withdraws	4
None	1	incomprehensible	2	Pain flexes	3
		None	1	Pain extends	2
				No response	1
GCS = A + B + C					
Step 2: Calculate the TRIAGE SORT SCORE					
GCS		Respiratory Rate		Systolic BP	
13 – 15	4	10 – 29	4	> 90	4
9 – 12	3	> 30	3	76 -89	3
6 – 8	2	6 – 9	2	50 – 75	2
4 – 5	1	1 – 5	1	1 -49	1
3	0	0	0	0	0
Step 3: Assign a TRIAGE PRIORITY					
12 = Priority 3					
11 = Priority 2					
< 10 = Priority 1					
Step 4 : Upgrade priority at discretion of senior clinician, dependant on the anatomical injury/working diagnosis					

Treatment delivery must be limited to that required in order to keep a patient alive and stable enough for them to reach further care.³⁶ Each intervention will require the time and skill-set of a particular healthcare professional; if this is not indicated, then it will occupy resources unnecessarily, and detract from the underlying aim.

A variation of the triage scoring system was developed by a Norwegian team in 2010 as taught in their version of the MIMMS course. They proposed: omission of the capillary refill as a sign of shock, renaming “dead” to lifeless and the replacement of paper tags to slap-wrap reflective tags.³⁷

Futuristic developments in the triage of patients at a major incident scene include: Standoff Patient Triage Tool (SPTT), which allows emergency responders to rapidly triage victims from a safe distance, especially in harsh, difficult to reach or high hazard areas. The device measures pulse, body temperature and respirations in 30 seconds. This is achieved with the use of: a laser Doppler vibrometer, an infrared camera and an image stabilization system. The research has shown that the optimal place for readings is the carotid artery.³⁸

Transport

The last key step is transport. This encompasses both the transport of the critically injured to the most appropriate facility, and the evacuation of the less seriously injured and walking wounded. Mode of transport is a paramount to disaster response decisions. Air, road or water is considered and unique to the situation and resources available. Care is required in managing transport to prevent overwhelming receiving hospitals and effectively relocating the major incident from the scene to the hospital.

Summary and Study Intent

The objectives of this study were (i) to describe the incident type related to total number in the study, (ii) to describe the severity in relation to total number of patients, (iii) to describe the weather conditions prevalent at incidents, (iv) to determine weather conditions associated with red triage category, and (v) to determine which vehicle types are involved in MVC's.

This is the first study to describe major incidents in an African setting. Understanding the types of incidents responded to and the injury severity of patients, will allow more robust planning for future similar incidents.

Further to this prevalence of incidents in particular traffic related "hot spots" can be identified and problems rectified.

References

1. The Annual Disaster Statistical Review 2011
<www.cred.be/sites/default/files/2012.07.05.ADSR > ;2011 accessed 20.11.2013
2. NHS Direct National Health Service Trust annual report and accounts 2010 -2011
<www.gov.uk/government/publications/nhs-direct-national-health-service-trust-annual-report-and-accounts-2010-to-2011.htm> ; 2011 accessed 16.03.2014
3. *10 Tips to Gear Up for MCI's-Major Incidents-@JEMS.com* 2010.< www.jems.com> 2010;
Accessed 10.06.2013
4. Advanced Life Support Group. Major Incident Medical Management and Support: The Practical Approach. London: BMJ Books; 2002
5. Smith W. Triage in Mass Casualty Situations *CME* November/December 2012 Vol. 30. No. 11 (2012)
6. One dead, 1000 displaced in Cape Town shack fires< www.enca.com/south-africa/one-dead-1000-displaced-cape-town > 2013; Accessed 13.03.2014
7. 1 fan dies + 19 injured in scaffolding collapse at Linkin Park Concert
<www.loudwire.com/one-fan-dies-several-injured-linkin-park-south-africa > 2012; accessed 5.01.2014
8. Khayelitsha Fire death toll rises <www.citypress.co.za/news/khayelitsha-fire-death-toll-rises-to-five. > 2013; accessed 08.08.2014
9. De Doorns Fatal Bus crash < www.iol.co.za/fatal-bus-crash-near-dedoorns. > 2010;
accessed 10.09.2013
10. Carley S, Macking-Jones K, Donna S. Major Incidents in Britain over the past 28 years: the case for centralized reporting of Major Incidents. *Journal of Epidemiology and Community Health* 1998; (52): 392-398
11. Carley S , Mackway-Jones K. The casualty profile from the Manchester bombing 1996: a proposal for the construction and dissemination of casualty profiles from major incidents. *J Accid Emerg Med* 1997; (14):76-80
12. University of Glasgow, Scotland Major Incident Guidelines <[www.gla.ac.uk/Schools/School of Medicine](http://www.gla.ac.uk/Schools/School%20of%20Medicine)> 2014; accessed 3.02.2014
13. Seyedin H, Ryan J, Sedeghi J. Lessons learnt from past and preparation for the future:

- how a developing country copes with major incidents. *Emergency Medicine Journal* 2009;
14. Fact box: Major shooting incidents in the United States
<www.reuters.com/article/2013/09/16/us-usa-navy-shooting-factbox> 2014; accessed 20.04.2014
 15. Fukushima earthquake-Tsunami Fast Facts <www.cnn.com/2013/07/17/world/.../japan-earthquake---tsunami-fast-facts > 2011; accessed 2.04.2014
 16. Driver in custody after 80 killed in Spain train crash < www.reuters.com/article/.../us-spain-train-id > 2013; accessed 10.02.2014
 17. 12 are killed at showing of Batman movie <www.nytimes.com/2012/.../shooting-at-colorado-theater > 2012; accessed 5.12.2013
 18. Norway Killings < [www.telegraph.co.uk/News/World News/Europe/Norway](http://www.telegraph.co.uk/News/World%20News/Europe/Norway)> 2011; accessed 10.03.2014
 19. 2011 Japan Earthquake-Tsunami Fast Facts <www.cnn.com/2013/07/17/world/.../japan-earthquake---tsunami-fast-fact > 2011 ; accessed 8.01.2014
 20. WHO Global Status Report on Road Safety 2013
<www.who.int/violence_injury_prevention/road_safety.../2013 > 2013; accessed 15.05.2014
 21. Wong K, Turner S, Boppana A, Nyent Z, Celtina T, Coster TD et al. Preparation for the next major incident: are we ready ? *Emergency Medicine Journal* 2006; (23): 709-712
 22. Mock C, Arreola-Risa C, Quanash R. Strengthening care for injured persons in less developed countries: a case study of Ghana and Mexico. *Inj Control Saf Promot* 2003 Mar-Jun; 10 (1-2): 45-51
 23. Van Hoving DJ, Smith WP, Kramer EP, de Vries S, Docrat F, Wallis LA. Haiti: The South African Perspective *S. Afr. Med. Journal* vol 100 no 8 August 2010
 24. Manesh A, Hedelin A, Ortenwall P. Regional co-ordination in medical emergencies and major incidents; plan , execute and teach. *Scandinavian Journal of Resuscitation and Emergency Medicine* 2009; 17: 32
 25. At least 87 dead in mass shooting, bombing in Norway
<www.cnn.com/2011/WORLD/europe/07/22/norway.explosion/> 2011; accessed 6.06.2014
 26. Integrated Emergency Management Course (IEMC)
<www.training.fema.gov/EMIWeb/iemc > 2014; accessed 20.01.2014
 27. McCormick S, Woodrope J, 12 Major Incidents, Leadership and Series Summary and Review. *Emergency Medical Journal* 2003; (20): 70-74

28. FEMA <www.fema.gov/incident-command-system > 2014, accessed 6.01.2014
29. Advanced Life Support Group. Major Incident Medical Management and Support: The Practical Approach. London: BMJ Books; 2002
30. London Assembly. Report of the 7th July Review Committee. June 2006
31. London Resilience Forum. "Looking Back, Moving Forward". The Multi-Agency Debrief. Lessons identified and progress since the terrorist events of July 2005. September 2006.
32. Hodgetts TJ. Lessons from the Musgrave Park Hospital bombing. *Injury* 1993; 24 (4): 219-221
33. London Assembly. Report of the 7th July Review Committee. June 2006 London Resilience Forum. "Looking Back, Moving Forward".
34. Burris D, Welling D, Rich N. Dominique Jean Larrey and the Principles of Humanity in Warfare. *J Am Col Surg* 2004; 198 (5): 831-835
35. Major Incident Medical Management and Support Handbook. MIMMS BMJ Books 2nd Edition 2009
36. Vassallo D J, Graham P J K, Gupta G, Alempijevic D J. "Bomb Explosion on the Nis Express" – Lessons from a Major Incident, Kosovo 16 Feb 2001. *Journal of the Royal Army Medical Corps*. 2005; (151): 19-20
37. Rhen M, Anderson JE, Vigerust T, Kruger AJ, Lossius HM, A concept for major incident triage: full scaled simulation feasibility study. *BMC Emergency Medicine* 2012; (10) : 17
39. Triage from a distance <www.jems.com.triage-from-a-distance > 2014; accessed 12.08.2013

PART B

ETHICS PROTOCOL AS APPROVED

**A DESCRIPTION OF MAJOR INCIDENTS IN THE
WESTERN CAPE**

RESEARCH PROPOSAL

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This study is in partial fulfilment of the M.Med (EM) degree

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1.INTRODUCTION

1.1 BACKGROUND

Major Incidents can be defined as any incident where the location, number, severity, or type of live casualties requires extraordinary resources.¹ In South Africa and most developing countries a major incident for a rural EMS is not the same as for a larger urban/metro service. In this EMS system (Western Cape) a major incident is declared at the discretion of the most senior EMS staff that is present at the incident.

According to MIMMS which the Western Cape uses as a guideline the definition used is: “any incident where the location, number, severity or type of live casualties requires extraordinary resources”

Most recent major incidents in the Western Cape include the bus accident at De Doorns (May 2010) , 2 hours from Cape Town in which 24 people were killed and 55 injured.² In August 2010 9 children died on their way to school when a taxi collided with a train at a level crossing in Blackheath, Cape Town.³

Each country has its own disaster preparation planning, training and resource complement, in the Western Cape this is the responsibility of the Metro EMS and the Emergency Medicine department at the University of Cape Town (UCT) and University of Stellenbosch. (SU) The Metro EMS system of the Western Cape is divided into 9 districts with the Cape Metropole divided into a further 4 divisions.

Each division has a distinct management and resource structure. There is currently a fleet of 250 emergency vehicles and a staff compliment of 1400 personnel. Of these vehicles there are 7 rescue vehicles, 1 disaster bus and 1 disaster medical facility which are transportable and house a fully equipped operating theatre .⁴ Along with the usual duties of the EMS it has

various special operations, these include: Wilderness search and rescue, urban search and rescue, Red Cross Air Mercy service and Disaster Medicine and Mass Casualty Management. The EMS command centre at Metro Control, Belville has the responsibility of co-ordinating all EMS responses and disasters, they field in excess of 40 000 calls per month. The training and preparedness for MI lies within the last mentioned branch of the special operations. This is achieved by MIMMS, HMIMMS and weeklong Disaster Medicine courses offered by the department.⁵

A contentious issue around the world is the use of resources related to major incidents in the third world. Large donations of money after an incident could rather be utilized for training beforehand to strengthen the current systems of disaster preparedness. This is evident in the MIMMS/HMIMMS programme and The Essential Trauma Care Program presented by WHO.⁶ In South Africa this was not too much of an issue as with the preparation for the Soccer World Cup in 2010.

Teaching and planning are emphasized in a Scandinavian study⁷. They highlight that an effective disaster response depends on a structured response between agencies and good communication. The presence of regional medical operational centres has shown to reduce mortality in disasters. They conclude that disasters are inevitable but with data accumulation, planning, research and practice they can be managed appropriately with minimal mortality and morbidity.

A comparative study in the Middle East (Saudi Arabia) in 2009 has similarities to South Africa in that they too are a developing country and the challenges are unique in terms of training, distances covered, staff availability and standards of facilities when it comes to coping with a major incident.⁸

The current South African studies that have been published in the Western Cape focus on severity scores and major incidents⁹. These are limited studies and the need for a descriptive

analysis of this database is evident.

Preparation has shown to reduce mortality and morbidity in major incidents, weak points in major incident preparation that have been identified is: Human resources (Staffing and training), physical resources (equipment, supplies and infrastructure), administration and organization.^{10,11}

This retrospective review of a database helps in part to identify any deficiencies in the current system in the Western Cape EMS and Major Incident planning.

Other UK studies highlight the preparation for and review of management of major incidents in the past and how they are able to improve on the performance of the various medical systems.¹²

International studies of major incidents either focus on describing a single type of incident eg: Hurricane Katrina, or reported major incidents over a period of time as done by Corley et al¹³, who have a database which collected major incident data over a 28 year period in the United Kingdom (UK). The analysis was divided into 3-4 major incidents per year, smaller incidents being public transport and larger incidents included civil disturbance and industrial accidents. Triage as a tool is essential in major incident on scene management and this is achieved by colour coding according to vital signs obtained... The colour coding used in this study is: (P1) Immediate (Red,) (P2) urgent (Yellow), (P3) Delayed (Green) and Deceased (Blue). The triage Sieve is the system taught in the MIMMS courses. (1) It is a major incident primary field triage tool constructed to prioritize patients for evacuation to definitive medical care. It is based on the assessments of the ability to walk, airway patency, respiratory and heart rate. Modification of triage systems is not uncommon to suit various countries or systems, mainly due to availability of resources. A Norwegian study¹⁴ called their version of the MIMMS the TAS-course. It is a two day course presented at no cost. Their triage modifications include: omission of capillary refill, renaming “dead” to lifeless and replacing the paper tags

with slap-wrap reflective tags.

One of the major data findings in this study will be triage colour coding in all the incidents described. There are no modifications from those taught on the MMIMS course.

Data collection from road traffic accidents is notoriously difficult. The WHO has published a manual that provides a practical guide for establishing a data system and will help with selection of evidence based interventions plus allow for better evaluation of progress.¹⁵ This manual will be used as a guide in the analysis of the data from the Western Cape.

1.2 MOTIVATION FOR THE STUDY

In a developing country such as South Africa where resources are already limited, the examination, description and analysis of previous major incidents is crucial for future planning and preparedness. From the results of this study we will have foresight into what types of incidents occur and where are the most vulnerable areas. By using the results training will be focused and resources channelled correctly.

This will be the first study to describe major incidents in an African setting. Understanding the types of incidents responded to and the injury severity of patients by using the triage sieve and sort system this will allow for more robust planning for future similar incidents.

Further to this prevalence of incidents in particular traffic related “hot spots” can be identified and problems rectified.

1.3 RESEARCH QUESTION

What is the current prevalence of major incidents in the Western Cape ?

1.4 AIM

To describe the location, type of major incident , severity (defined by resources utilized) and number of patients triaged and treated, as well as patient characteristics involved in motor vehicle crashes (MVC’S)

1.5 OBJECTIVES

The objective of this study is then to describe a

- (i) incident type related to total number in the study
- (ii) severity in relation to total number of patients
- (iii) weather conditions prevalent at the incident
- (iv) weather conditions associated with red triage category
- (v) monthly variation trend and
- (vi) vehicle types in the MVC's to consider a dominant category.

2. METHODOLOGY

2.1 STUDY DESIGN

A retrospective review of the Western Cape Major Incident database will be performed for the period 1 December 2008 to 30 October 2012. Summary statistics will be used to describe all variables.

2.2 STUDY SETTING

The Western Cape is one of 9 provinces in South Africa. It is at the southernmost tip of the continent. Surrounded by 2 oceans, the Indian and Atlantic oceans. It spans an area of 129 462 square kilometres and shares a total area of 10.6% of the country. It has a population of 5.2 million and the languages percentage wise include: Afrikaans 55%, English 19% and isiXhosa 23%. The capital being Cape Town. ¹⁶

A Major Incident data form was designed by the Division of Emergency Medicine at UCT and SU (Appendix 1) so as to attempt to quantify the extent of the perceived problem in the Western Cape.

Inclusion criteria: “ any incident where the location, number, severity or type of live casualties requires extraordinary resources “

Exclusion criteria: Single incidents with no need for extra EMS staff or multiple agencies.

2.3 DATA COLLECTION

The data sheets were filled in by EMS officials present on the scene of the various incidents. The following variables were collected: Patient numbers, colour triage, location, weather, incident type, services involved, metro EMS vehicles involved and patient details. On completion, these sheets were sent to a central office where the data was transcribed onto an Excel database.

2.4 SAMPLING

No sampling needed. All data in the database from November 2008 to February 2011 will be analysed. 1 person will be capturing the data on scene and 1 person will capture the data in the Excel data base. No checking of the integrity of the data will be done due to resource limitations.

2.5 DATA MANAGEMENT

The database will be stored on a password protected work computer. Access to the data will be limited to the principal investigator and his supervisors.

3. STATISTICAL ANALYSIS

The primary aim was to analyse the trends of Major Incidents in the Western Cape.

Summary statistics will be used to describe the variables. Distributions of variables will be presented with histograms and or frequency tables. Medians or means will be used as the measures of central tendency for ordinal and continuous responses and standard deviations and quartiles as indicators of spread.

A p-value of $p < 0.05$ will represent statistical significance in hypothesis testing and 95% confidence intervals will be used to describe the estimation of unknown parameters.

4. Table 1: TIME PLAN

	SEPTEMBER	OCTOBER	NOVEMBER
ETHICS	X		
ANALYSIS		X	
REPORTING RESULTS		X	
WRITING + SUBMISSION			X

5. ETHICAL and LEGAL CONSIDERATIONS

Anonymity is ensured as no names of patients were captured, no vehicle types were noted and no registration of any vehicle was recorded in the database. All data will be treated as confidential. The data will be stored on a password-protected work computer and only the researchers will have access. Approval from EMS will be obtained.

6. LIMITATIONS

These include:

Incomplete data forms, accuracy, capturing errors, on scene and office data capturing, missing variables, statistical errors and cross checking errors

These errors can be minimized by training of the staff who document the on-scene data, use of explicit protocols for case selection or exclusion, periodic meetings to review problems, monitoring of the data capturing and considering a second reviewer to randomly check the database for errors.

7. DISSEMINATION OF RESULTS

The results will be used to monitor trends in Major Incidents in the Western Cape and how to improve future training and on-scene management of major incidents.

The results of the study can also help influence and modify the current preventative strategy adopted by the various law enforcement agencies in the province. It could also influence provincial authorities to review applicable legislation that may in turn mitigate the frequency of such incidents.

For these reasons it will be important to ensure that the results are disseminated to all the relevant authorities. These include the stakeholders: EMS management, relevant peer review journals and the Emergency Medicine Conference in November 2011 (Cape Town)

8. FUNDING

The study is self-funded.

Table 2: Budget and Motivation

	Cost
Stationery	100
Telephone	150
Printing of Data Sheets	1000
Internet	200
Fuel/Petrol	450
Statistician (@ R175/hr)	175
TOTAL	2075

9. REFERENCES

1. Major Incident Medical Management and Support Handbook. MIMMS
BMJ Books 2nd Edition 2009
2. Digital Journal [homepage on the internet] South Africa [cited February 2011]
Available from: <http://www.digitaljournal.com/>
3. ER24 Blog [homepage on the internet] South Africa [cited February 2011] Available
from : <http://www.blog.er24.co.za>
4. Western Cape EMS [homepage on the internet] South Africa [cited March 2011]
Available from: [http:// www.metroems.org.za](http://www.metroems.org.za)
5. Emergency Medicine Society of South Africa [homepage on the internet]South Africa
[cited March 2011] Available from: [http://:www.emssa.co.za](http://www.emssa.co.za)
6. Goosen J, Mock C, Quansah R Preparing and responding to mass casualties in the
developing world International Journal Injuries Saf Promot 2005 Jun; 12(2): 115-117
7. Manesh A, Hedelin A, Ortenwall P. Regional co-ordination in medical emergencies
and major incidents; plan, execute and teach. Scandanavian Journal of Resuscitation
and Emergency Medicine 2009; 17 :32
8. Seyedin H, Ryan J, Sedeghi J. Lessons learnt from the past and preparation for the
future: how a developing country copes with major incidents. Emergency Medicine
Journal 2009:
9. Wallis L, Carly S. Comparison of paediatric major incident primary triage tools.
Emergency Medicine Journal 2006; 23: 475-478
10. Wong K, Turner S, Boppana A, Nyent Z, Celtina T, Coster TD et al. Preparation for
the next major incident: are we ready? Emergency Medicine Journal 2006; 23 : 709-
712
11. Mock C, Arreola-Risa C, Quansah R Strengthening care for injured persons in less
developed countries: a case study of Ghana and Mexico Inj Control Saf Promot 2003
Mar-Jun; 10 (1-2): 45-51

12. McCormick S, Woodrope J. Article 12 Major Incidents, leadership and series summary and review. *Emergency Medical Journal* 2003; 20: 70-74
13. Corley S, Macking-Jones K, Donna S. Major incidents in Britain over the past 28 years: the case for centralized reporting of major incidents. *Journal of Epidemiology and Community Health* 1998; 52: 392-398
14. Marius R, Andersen J E, Vigerust T, Kruger A J, Lossius H M A concept for major incident triage: full-scaled simulation feasibility study *BMC Emergency Medicine* 2010; 10:17
15. United Nations Road Safety Collaboration. Data Systems: a road safety manual for decision makers and practitioners. 2009 [cited April 2011] Available from : <http://www.who.int/roadsafety/projects/manuals/data/en/index.html>
16. South Africa info [homepage on the internet] [cited March 2011] Available from: <http://www.southafrica.info/about/geography/western-cape.htm>

PART C

**ARTICLE FOR SUBMISSION TO THE AFRICAN JOURNAL OF
EMERGENCY MEDICINE**

**MAJOR INCIDENTS IN THE WESTERN CAPE PROVINCE OF SOUTH AFRICA: A
DESCRIPTIVE STUDY**

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Keywords:

Major Incidents; South Africa

Word count: 2192

Tables: 3

Figures: 3

There is no conflict of interest

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ABSTRACT

Introduction: Major incidents appear to be on the increase, but there is no data in the African context. The Western Cape Emergency Medical Services have collected data on every major incident responded to since December 2008. This study describes the major incidents that occurred within the Western Cape Province of South Africa.

Methods: A retrospective review of the Western Cape Major Incident database was performed for the period 1 December 2008 to 30 October 2012. Summary statistics were used to describe all variables.

Results: Five hundred and sixty five major incidents occurred during the 49 month study period (mean per month = 11.5, range 3 - 29). A total of 6473 patients were involved (mean per incident = 11.5), of whom 23.1% were children. Almost 60% occurred in rural areas. Motor vehicle accidents were by far the most frequent cause (n=499, 88.6%). Most patients only suffered minor injuries (triaged green n=2554, 55%); 1962 (30%) of patients were moderately injured (triaged yellow) while 584 (9%) patients were severely injured (triaged red). Six percent (n=372) of patients died. The majority of major incidents occurred in light conditions (n=313, 55.7%), in Dark 231 (41%), 10 (1.8%) in rain and 1 (0.2%) in snow.

Conclusion: Major incidents occur frequently in the Western Cape, are overwhelmingly traffic related and regularly involve children; this has certain implications for planning and response.

INTRODUCTION

The tsunami of 26 December 2004 will long be remembered for the number of deaths that it caused (over 250,000).¹ Although this single incident contributed to the total of four times the number of deaths from disasters in comparison with previous years, the total number of people affected by such events each year is many times higher. Whilst a disaster is typically thought of as a naturally occurring event (e.g. earthquake or tidal wave), a mass casualty situation may occur from a natural or man-made source (e.g. mass transportation collision or industrial fire). In many countries, mass casualty situations tend to be referred to as Major Incidents. Although a standard understanding of what constitutes a major incident has not been agreed, with the term being interchanged with both mass casualty incident and disaster, for Health Services a major incident may be considered to be:

“any occurrence which presents a serious threat to the health of the community, disruption to the service or causes (or is likely to cause) such numbers or types of casualties as to require special arrangements to be implemented by hospitals, ambulance services or health authorities.”²

This definition is intentionally broad; covering a variety of different incidents, from outbreaks of food poisoning to planning for mass gatherings. However, major incidents are generally regarded as events which occurrence is sudden and unpredictable, resulting in a large number of live casualties presenting to the emergency services over a short period of time. Major incidents are also becoming more frequent, and are affecting more people (Table 1).³

Table 1 Examples of recent international high profile major incidents

DATE	LOCATION	TYPE	CASUALTIES
July 2013⁴	Spain	Train derailment	80 dead, 140 injured
July 2012⁵	Colorado, USA	Cinema Shooting	12 dead, 71 injured
July 2011⁶	Oslo & Utoya Island, Norway	Explosion & Shooting	77 dead, 319 injured
March 2011⁷	Oshus, Japan	Tsunami	15 889 dead, 6152 injured

The point at which a major incident is declared depends on the ability of the health service resources to cope with the patient load.⁸ Major incidents may therefore occur with relatively small numbers of live casualties if healthcare resources are scarce; this is particularly likely to occur in low and middle income countries where resources are limited at the best of times. There is currently very limited data on major incidents in South Africa. The lack of data makes planning for major incidents very difficult. The study aimed to describe major incidents in the Western Cape province of South Africa. This study describes the major incidents that occurred within the Western Cape Province of South Africa.

METHODS

Study Design

A retrospective analysis of a prospectively collected database was done of all major incidents in the Western Cape between 1 December 2008 and 30 October 2012. The study was approved by the University of Cape Town Human Research Ethics committee (Ref: 441/2011).

Study Setting

The Western Cape major incident database was started on 1 December 2008. A major incident is defined as “ any incident where the location, number, severity or type of live casualties requires extraordinary resources”

Standardised data sheets were completed at every major incident by the most senior member of the provincial Emergency Medical Services (EMS). Variables captured included

basic descriptive details, type of incident, prevailing weather conditions, emergency services involved, and patient details such as triage score, age, gender and disposition. No actual names of patients were recorded on the datasheets. The sheets were stored at the EMS headquarters in Cape Town before being captured onto a Microsoft Excel® datasheet on a password protected work computer. Access is restricted to the senior management of the Western Cape EMS.

Study population

All data in the Western Cape Major Incident database was analysed for the period 1 December 2008 till 30 October 2012. Incomplete data points were excluded.

Data Collection and Management

Variables related to patient demographics (age, gender, injury severity) and incident details (Date, time, location, type, and weather) were accessed. Patients 12 years of age or older were classified as adults and injury severity was assessed according to the Triage Sieve Tool.⁸ Data was stored on a password protected work computer and access limited to the research team.

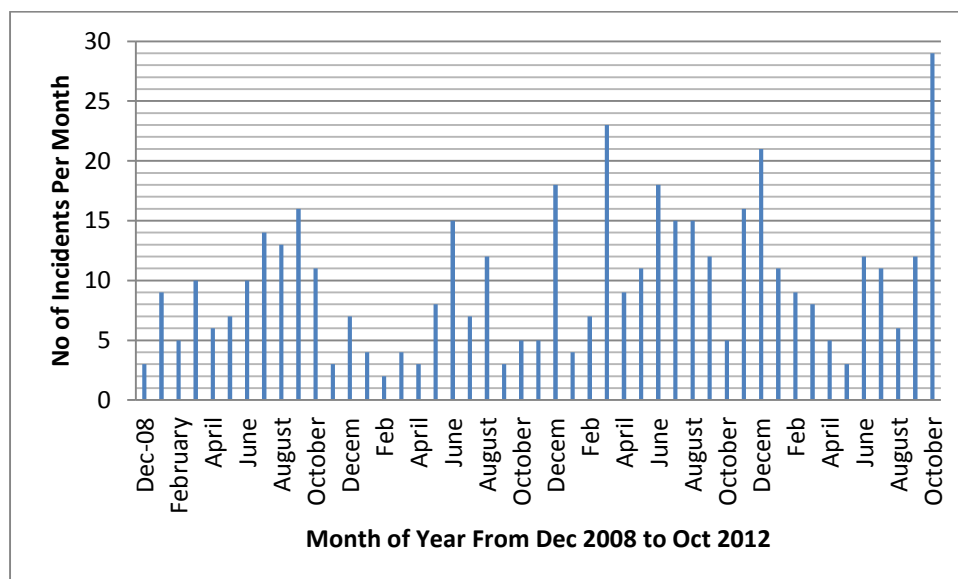
Data Analysis

Summary statistics were used to describe all variables. Means were used as measures of central tendency with range and percentages as indicators of spread. The mode was used as the measure of central tendency for nominal variables.

RESULTS

In the 49 months studied, the total number of incidents before exclusions was n=593. The total number data sheets excluded n= 28 sheets. Of those, n=22 were urban and n=6 were rural, remaining with 565 major incidents (mean 11.5 / month). The annual incidence varied quite widely; the least number of major incidents (n=95) occurred during 2010 compared to the highest (n=176) in 2011. The monthly incidence also varied significantly, with the lowest number (n=3) in November 2009 and the highest (n=29) in October 2012.

Figure 1 Monthly variation of major incidents



A total of 6473 patients (mean 11.5 / incident) were involved, 23.1% (n=1496) of whom were children. Motor Vehicle Crash (MVCs) was the most frequent type of major incident (n=499, 88.6%) (Table 2). Public transport accounted for 243 (43.1%) major incidents.

Table 2 Major incidents per Incident type

		Incidents n, %	Patients n, %
Motor Vehicle Crash		499, 88.6%	5776, 89.2%
	<i>Car</i>	214, 38.0%	
	<i>Taxi</i>	199, 35.3%	
	<i>Bus</i>	44, 7.8%	
	<i>Truck</i>	42, 7.5%	
Fire		5, 0.9%	20, 0.3%
Chemical		3, 0.5%	33, 0.5%
Gas leak		3, 0.5%	33, 0.5%
Interpersonal Violence		2, 0.4%	19, 0.3%
Aeroplane		2, 0.4%	12, 0.2%
Other		51, 9.1%	580, 9%

The majority of patients were triaged green (n=3554, 55%), followed by yellow (n=1963, 30%) and red (n=584, 9%) (Table 3). There were 372 (6%) dead patients, of which 49 (13.2%) were children.

Table 3. Injury severity according of patients involved in major incidents (divided to gender and age)

		Red		Yellow		Green		Blue		Total	
		n	%	N	%	n	%	n	%	n	%
Adult	Male	293	10.92	920	34.28	1263	47.06	208	7.75	2684	41.46
	Female	180	7.85	849	37.03	1149	50.11	115	5.02	2293	35.42
Child	Male	71	12.20	106	18.21	378	64.95	27	4.64	582	8.99
	Female	40	4.38	88	9.63	764	83.59	22	2.41	914	14.12
Total		584	9.02	1963	30.33	3554	54.90	372	5.75	6473	100

Red=Critical, Yellow=Urgent, Green=Minor, Blue=Dead

More than half of all major incidents occurred in light conditions (n=313, 55.7%); the remaining in dark conditions (n=231, 41%), rain (n=10, 1.8%), snow (n=1, 0.2%) and other (n=8, 1.4%). Of those that occurred in light conditions 264 (85%) were urban and 49 (15%) were rural. The incidents that occurred in dark conditions totalled 154 (66%) in urban and 77 (33%) rural.

Figure 2: Light conditions vs. Region

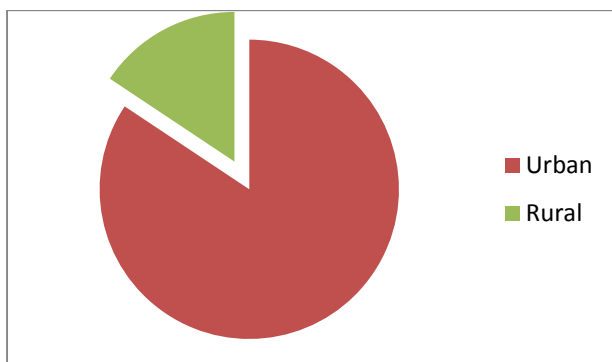
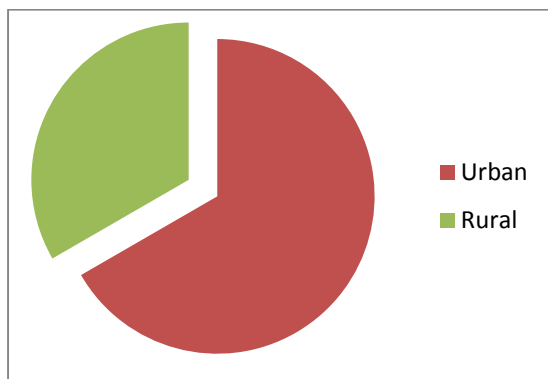


Figure 3: Dark conditions vs. Region



DISCUSSION

Major incidents occurred frequently within the Western Cape. The mean of 11.5 incidents per month is very high compared to data from Britain where major incidents occurred 3 to 4 times per year (range 0-11).⁹ The data from the UK study is outdated and the authors acknowledge difficulty in obtaining accurate data; making it difficult to draw comparisons to our study.⁹ It is also likely that the occurrence of major incidents was underestimated.

MVC's were by far the most frequent type of major incident reported (n=565, 88.6%). This is again significantly higher than the 59% reported in Britain.⁹ A 2010 World Health Organization (WHO) report indicated that middle-income countries have the highest annual road traffic fatality rates (20.1 per 100 000 population); compared to 8.7 per 100 000 in high-income countries.¹⁰ This indicates that these countries bear a disproportionately high burden of road traffic deaths relative to their level of motorization. There are also large disparities in road traffic death rates between regions. The risk of dying as a result of a road traffic injury is highest in the African Region (24.1 per 100 000 population) and lowest in the European Region (10.3 per 100 000).¹⁰ The higher prevalence in low to middle income countries is apparently due to the fact that only 28 countries (representing 7% of the world's population), have adequate laws that address five of the prominent risk factors (speed, drink– driving, helmets, seat-belts and child restraints) for road traffic related deaths.¹⁰

The expectation on study initiation was that taxis would account for the majority of traffic related incidents; the 35% of major incidents attributed to taxis were therefore not surprising. Based on the data from Stats SA of 2013 the percentage of workforce that use taxi's everyday is currently 68%. (Bus:20% and Train:13%) . This then would explain the higher incidence of MVC's that involve taxi's due to higher percentage of utilization.

Approximately 14 million South Africans use taxis every day and there are only 200 000 officially registered taxi's in South Africa.¹¹ Public transport in South Africa (buses and trains) are entirely inadequate and as a result the taxi industry has been allowed to develop. The legacy of apartheid and the "Group areas Act" created a physical and social divide which contributed to the need for an informal transport service. Lack of official regulation led to abuse of the registration process and un-roadworthy vehicles. Reckless driving and alcoholism also occurs daily.¹¹ The Western Cape Traffic Department is actively trying to alleviate this problem by regular random taxi checks and patrolling on the highway with unmarked police cars. Public transport relating to buses is inadequate to service the Western Cape population, hence used less frequently and reflected in the relatively lower number of major incidents. When compared with other areas of South Africa, heavy industrial and mining industries do not exist, thus the use of heavy duty trucks is considerably less, leading to only 7.5% of major incidents in the Western Cape. Interestingly, our findings are in contrast to Nigeria, an African with similar economy and growth. Their study showed a higher incidence of motorcycle related injuries compared to motor vehicles and taxi's.¹² The authors emphasized that rapid unplanned industrialisation and urbanisation in developing countries has led to an increase in high velocity vehicular type injuries; to such an extent that it has surpassed under-nutrition and certain infections.¹²

Triage as a system is essential during major incidents when resources outstrip demands.¹³ The Western Cape has implemented the Triage Sieve as the triage tool to use during major incidents. Although our study indicated high patient numbers per incident (mean = 11.5), most patients (55%) sustained only minor injuries. This was also reported in major incidents that occurred in Britain.¹⁴

Children are an inevitable part of the patient load from major incidents and can range from 10% to 100% of all casualties.¹⁵ Children were involved in almost a quarter of the major incidents, although they had a lower overall mortality than adults (3.2% vs 6.5%). Problems encountered with children in major incidents are related specifically to triage, they tend to be placed in a higher category due to concerns from the health care workers e.g. fear of missing a crucial injury.¹⁵ They too have a large amount of empathy for an injured child who could influence a triage decision and the natural nurturing instinct of most adults to do all that is possible for an injured child regardless the extent of the injuries. Paediatric major incident scoring systems (e.g. Paediatric Triage Tape, Simple Triage and Rapid Treatment (START) and JumpSTART) that have been developed eliminate some of these problems. It is advised that these paediatric specific triage scores be implemented if the mass casualty incident exclusively involves children (e.g. school bus accident). This then can be grouped as the “Eichelberger modification” to be used when there is more than five children aged 3 years or younger.

LIMITATIONS

As this study is a retrospective analysis of a prospectively collected database there is no external method available to confirm that EMS staff appropriately declared a major incident or that data were recorded accurately at the time of the incident. All EMS personnel have received similar training which included the MIMMS definition of a major incident. The transcription process was done by a single research assistant and wasn't cross-checked. Errors might have occurred and could influence the results of the study. This study was limited to the Western Cape and may not be representative of other regions within South Africa. However, as the first report on such events, we believe that it has great value.

CONCLUSION

This is the first study to describe major incidents in an African setting. We have demonstrated a high frequency with high patient loads. Understanding the types of incidents responded to and the injury severity of patients will allow for more robust planning for such incidents in the future. More research which could focus on MVC's exclusively is definitely indicated based on the results. With the evidence policy changes

could occur in the relevant departments and thus reduce major incidents related to MVC's. Expansion of the data to focus more on Urban vs. Rural, and the factors which separate the two and why the disparity plus response times of urban vs. rural.

A further expansion of the major incident theme would be greater dissection of the prevailing weather conditions and possibly road conditions at the time of the major incident. These all would also have a large influence on resource allocation and policy changes in the Western Cape.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

1. *Indian Ocean Tsunami 2004* <www.en.wikipedia.org/wiki/2004/Indian/Ocean/Earthquake.htm>; 2004 accessed 20.06.2014.
2. *NHS Direct National Health Service Trust annual report and accounts 2010 -2011* <www.gov.uk/government/publications/nhs-direct-national-health-service-trust-annual-report-and-accounts-2010-to-2011.htm> ; 2011 accessed 16.03.2014
3. *The Annual Disaster Statistical Review 2011* <www.cred.be/sites/default/files/2012.07.05.ADSR > ;2011 accessed 20.11.2013
4. *Driver in custody after 80 killed in Spain train crash* < www.reuters.com/article/.../us-spain-train-id > 2013; accessed 10.02.2014
5. *12 are killed at showing of Batman movie* <www.nytimes.com/2012/.../shooting-at-colorado-theater > 2012; accessed 5.12.2013
6. *Norway Killings* < [www.telegraph.co.uk/News/World News/Europe/Norway](http://www.telegraph.co.uk/News/World%20News/Europe/Norway)> 2011; accessed 10.03.2014
7. *2011 Japan Earthquake-Tsunami Fast Facts* <www.cnn.com/2013/07/17/world/.../japan-earthquake---tsunami-fast-fact > 2011 ; accessed 8.01.2014
8. Advanced Life Support Group. Major Incident Medical Management and Support: The Practical Approach. London: BMJ Books; 2002
9. Carley S, Mackway-Jones K, Donnan S. Major incidents in Britain over the past 28 years: the case for the centralised reporting of major incidents. *J Epidemiol & Community Health* 1998; 52:392-398
10. *WHO Global Status Report on Road Safety 2013* <www.who.int/violence_injury_prevention/road_safety.../2013 > 2013; accessed 15.05.2014
11. *Inside SA's 40 Billion Rand Taxi Industry* <www.moneyweb.co.za/taxi/industry/ 2014; accessed 14.06.2014.
12. Adoga AA, Ozoilo KN. The Epidemiology and type of injuries seen at the accident and emergency unit of a Nigerian referral centre. *Journal of Emergencies, Trauma and Shock*. 2014;7(2):77-82
13. O'Meara M, Porter K, Greaves I. Triage. *Trauma*. April 2007; 9 (2): 111-118
14. Carley S , Mackway-Jones K. The casualty profile from the Manchester bombing 1996: a proposal for the construction and dissemination of casualty profiles from major incidents. *J Accid Emerg Med* 1997; 14:76-80
15. Mackway-Jones K, Carley SD, Robson J. Planning for major incidents involving children by implementing a Delphi study. *Arch Dis Child* 1999;80(5):410-413

PART D

SUPPORTING DOCUMENTS

- 1. ETHICS APPROVAL LETTER (UCT)**
- 2. INSTRUCTIONS TO AUTHORS (AFJEM)**



30 September 2011

HREC REF: 441/2011

Dr H Lategan
c/o Prof L Wallis
Emergency Medicine
Department of Medicine
J-17, OMB

Dear Dr Lategan

PROJECT TITLE: A DESCRIPTION OF MAJOR INCIDENTS IN THE WESTERN CAPE

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

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

Approval is granted for one year till the 30 October 2012.

Please submit a progress form, using the standardised Annual Report Form (FHS016), if the study continues beyond the approval period. Please submit a Standard Closure form (FHS010) if the study is completed within the approval period.

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

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

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Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

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AFRICAN JOURNAL OF EMERGENCY MEDICINE: INSTRUCTIONS FOR AUTHORS

TYPES OF ARTICLES

Original Research: Original studies of basic or clinical investigations in areas relevant to emergency medicine. Reference to the relevance of the research in a resource poor setting is essential and should be alluded to in the discussion section. References and a structured abstract (see Preparation below) are required. Maximum length: 3,000 words, 5 tables and/or figures, plus the abstract (300 words) and references (max 50). The checklists found on the following websites should be used to structure your manuscript (a completed checklist should be submitted with your manuscript):

- For randomised control trials: <http://www.consort-statement.org>
- For cohort, case-control, and cross-sectional studies: <http://www.strobe-statement.org/>
- All other studies: <http://www.equator-network.org/resource-centre/library-of-health-research-reporting/>

Review Articles (commissioned): Extensive reviews of the literature on a narrow clinical topic. References must include, but need not be limited to, the past 3 years of the literature. A narrative abstract is required (see Preparation below). Review articles should focus on best evidence in an ideal as well as a resource poor setting. Maximum length: 3,000 words, plus the narrative abstract (max 300 words) and references (max 50). For Systematic reviews and meta-analyses a Prisma checklist (<http://www.prisma-statement.org>) should be used to structure your manuscript (a completed checklist should be submitted with your manuscript)

Case Reports: Brief descriptions of a previously undocumented disease process, a unique unreported manifestation or treatment of a known disease process, or unique unreported complications of treatment regimens. Case reports should be structured as follow: Introduction, Case report and Discussion. They should not contain an exhaustive review of the literature. A structured abstract (see Preparation below) is required. Maximum length: 1,000 words, plus abstract (max 150 words) and references (max 10), and 1 table or figure.

Abstracts for Africa: Research abstracts can be submitted for publication, providing a concise summary of original work not published elsewhere. Case reports and narrative abstracts are not accepted for publication in Abstracts for Africa. An abstract is not required. Please enter: Not applicable, Abstracts for Africa when prompted to enter an abstract. Upload your manuscript containing title and abstract when prompted. Maximum length: 300 words plus maximum of one table/ figure and three references are allowed. The Strobe checklist for conference abstracts (<http://www.strobe-statement.org/>) should be used to structure your manuscript (a completed checklist should be submitted with your manuscript).

Practical Pearl: Descriptions of novel approaches to provision of emergency care; and practical "tricks of the trade" describing aspects of emergency medicine management. An abstract is not required (enter: Not required, practical pearl when prompted). Maximum length: 800 words, 5 tables and/or figures and references (max 5). A manuscript template is available at <http://www.afjem.com/> and can be used for submission. Note that author details should be included in the manuscript.

Brief Research Reports: Reports of preliminary data and findings or studies with small numbers demonstrating the need for further investigation. References and a structured abstract (see Preparation below) are required. Maximum length: 1,500 words, plus the abstract (max 300 words) and references (max 10) and 3 tables and/or figures. Checklists described for original research above should be used to structure your manuscript (a completed checklist should be submitted with your manuscript)

Concepts: Descriptions of clinical and nonclinical problems and solutions; descriptions of novel approaches to planning, management, or provision of emergency services; and practical "how-to" articles describing aspects of emergency medicine management (includes African country acute care profiles). A narrative abstract (see Preparation below) is required. Maximum length: 3,000 words, plus the abstract (max 300 words) and references (max 50).

Editorials (commissioned): Authoritative comments or opinions on major current problems of emergency physicians or on controversial matters with significant implications for emergency medicine; or, qualified, thorough analysis and criticism of articles appearing in AfJEM. Maximum length: 1,500 words plus references (max 5). An abstract is not required

Brief Commentaries (commissioned): Brief discussion focusing on 1 or 2 key points about a single study—strengths, weaknesses, where it fits in the context of other studies, controversies, how it should or should not change our clinical practice, or how it illustrates some important principle of science or methodology. Maximum length: 750 words plus references (max 5).

Case Conferences (commissioned): Presentation and discussion of a case by an expert, focused on the problem-solving approach toward a particular clinical problem and discussion of differential diagnoses and subsequent management at various stages of the patient's evaluation. Maximum length: 3,000 words plus the abstract (max 300 words) and references (max 50).

Correspondence: Discussion, observations, opinions, corrections, and comments on topics appearing in AfJEM; very brief reports or other items of interest. Maximum length: 500 words, plus references (max 5). An abstract is not required. Please enter: Not applicable, Correspondence when prompted to enter an abstract. Letters discussing an AfJEM article should be received within 6 weeks of the article's publication. The article must be included in the references. Authors of articles about which letters are received will be given the opportunity to reply, which will not be shared with the letter writer prior to publication. Letters of political or other topics unrelated to the science of medicine, as well as those containing personal criticisms, will not be published.

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PREPARATION

Submission

checklist

The following list will be useful during the final checking of an article prior to sending it to the journal for review. Please consult the rest of the preparation guide for further details of any item. Any manuscript which did not adhere to this guidance will be returned to the authors for correction before being processed further.

Ensure that the following items are present:

Cover letter

- Details of related papers published or submitted for publication
- Details of previous reviews of the submitted article
- Indication as to whether any of your manuscript (for example, appendices, large tables) could be published as Web only files rather than in the print version of the article. Please label any files for online publication with this designation.
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Title page

- Title
- Author names, affiliations and contribution
- Word count
- Number of figures and tables
- Conflict of interest statement
- Corresponding author

Manuscript

- Title
- Ensure that any author identifiers are removed
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- Content as per article type (tables included in text)
- Correct reference structure
- List of figure captions as per guidance below

Further considerations

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- Conflict of interest statement included both in title page and when prompted by submission system
- Manuscript has been "spellchecked" and "grammar-checked" using English UK
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- References are in the correct format for this journal (see below)
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Detailed preparation guidance

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Acknowledgements

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Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. References for the design of the study and complex or unusual statistical methods should be to standard works when possible (with pages stated). Commonly used methods such as the chi-square test, t-test, ANOVA, linear and logistic regression need not be referenced. Define statistical terms, abbreviations, and most symbols. Technical statistical terms should ideally be replaced by simpler terms where possible and referenced if not. Specify the computer software used. The results section must be written so the average reader can understand the findings. The methods section is allowed to be more complex if unavoidable. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). For normally distributed data give means and confidence intervals and for data that is not normally distributed give the median and interquartile range. Avoid relying solely on statistical hypothesis testing, such as p-values. If p-values are used, include 2 digits of precision (i.e. $p=0.65$) for values greater than 0.01. Give 3 digits for values between 0.01 and 0.001 and report values smaller than 0.001 as $p < 0.001$. Describing non-significant p-values as NS is not acceptable and a numerical value should be given. When using tables consider including counts and percentages. In general, including the chi-square statistic, t statistic, F statistic and degrees of freedom is not useful. Regression output should be limited to the most important findings. Estimates of variance explained (R^2 , correlation coefficients, and standardized regression coefficients or effect size) should not be presented as the main result of the analysis.

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