Orthopaedic Terror Medicine:
An assessment of a cohort of Johannesburg Orthopaedic surgeons' response to a questionnaire on their hospital's preparedness for injuries associated with an explosive type terrorist attack.

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Medicine

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Declaration

I, Adam Hirschmann, declare that this research report in the format of a “submissible” paper is my own, unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Orthopaedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

18th day of October 2021 in Waverley, Johannesburg.

Presentations arising from the research project

1. Podium presentation at the 1st Cape Town International Trauma Conference in November 2017 at the Vineyard Hotel. The presentation title was: Orthopaedic Terror Medicine: Are we ready to deal with the injuries sustained from an intentional mass casualty incident in South Africa? Author: Dr Adam Hirschmann / Co-author: Dr Brad Gelbart / Co-author: Prof Chris Frey
2. Poster Presentation at the WITS School of Clinical Medicine Research Day 2019: Orthopaedic Terror Medicine: Are we ready to deal with the injuries sustained from an intentional mass casualty incident in South Africa? Author: Dr Adam Hirschmann / Co-author: Dr Brad Gelbart / Co-author: Prof Chris Frey

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Nomenclature

HCA	High Care Area
HOD	Head of Department
ICU	Intensive Care Unit
MCI	Mass Casualty Incident
n	Sample size
p	Probability
P1	Priority 1 / Critical Patient
phi	Phi Coefficient
SAOJ	South African Orthopaedic Journal

“Submissible” format of a paper

Orthopaedic Terror Medicine:

An assessment of Orthopaedic Surgeons’ response to a questionnaire on preparedness relating to an explosive type terrorist attack in the greater Johannesburg area

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Abstract:

Background:

International terrorism has claimed an average of 21 000 deaths per year over the past decade with the highest total being in 2015 with 35 320 injuries and resulted in 28 328 deaths. The medical management of terrorist victims has given birth to a new branch of Emergency and Disaster Medicine called *Terror Medicine*. Multi-modal types of terrorism creates significant orthopaedic injuries amongst survivors through a combination of blast, penetrating and blunt force mechanisms. The aim of this research was to assess the current perception of preparation amongst orthopaedic surgeons in a selection of Johannesburg public and private hospitals to an explosion type terrorist attack.

Methods:

Ethical approval was granted to distribute the author's questionnaire which covered a wide range of topics related to multidimensional trauma and the possible requirements of the healthcare providing facility. The questionnaire was distributed to 101 orthopaedic surgeons working at both public and private hospitals in the greater Johannesburg area. Descriptive analysis of all question responses was undertaken and the responses between public and private hospitals were compared.

Results:

Of the 39 orthopaedic surgeons who participated in the study, 22 completed the questionnaire from the private sector and 17 from the public sector. There was a significant, strong association with the hospital sector (p=0.0049; Cramer's V=0.52): 53% of respondents from state hospitals reported preparedness, compared to only 9% from private hospitals. There was a significant, moderate association with the hospital sector (p=0.031; Cramer's V=0.42): n=10 of 17 (59%) of state respondents reported having a standby protocol (whereby additional orthopaedic surgeons can be activated on site in the event of an mass casualty incident), compared to only n=4 of 22 (18%) from private hospitals.

Conclusion: The study results suggest that public hospitals appear to have access to higher numbers of staff and theoretically, more readily available equipment compared to private hospitals. In the event of a terrorist mass casualty incident, there will be a need for a well-established public/private hospital partnership. A national assessment of hospital preparedness is recommended. As well, the development of a Terror-Medicine course that is offered at a post-graduate level is encouraged.

Introduction and literature review

Terrorism has been defined as “the calculated use/or threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious, or ideological” (1). International terrorism has claimed an average of 21 000 deaths per year over the past decade with the highest total being in 2015 with 35 320 injuries and resulted in 283 28 deaths (2, 3). The medical management of terrorist victims has given birth to a new branch of Emergency and Disaster Medicine called *Terror Medicine* (4, 5).

Among the countries with the highest number of fatalities and injuries from terrorist attacks, Africa features prominently. It is therefore worthwhile knowing how prepared South African hospitals are in dealing with the injuries sustained during a terrorist attack. Developing a hospital specific response plan and training it regularly results in better prepared staff, the ability to call in more staff, additional stock, a pre-determined hierarchy and line of communication, the ability to transfer cold cases to peripheral hospitals and the ability to lock down a hospital from a security perspective.

Terrorist attacks can be categorised as conventional and non-conventional (1, 6). Conventional attacks include explosive type, shooting, vehicular ramming and stabbing attacks whilst non-conventional includes nuclear, biological and chemical type attacks (1, 6, 7). This research study is focussed on the hospital preparation for a conventional blast-type terrorist attack.

In conventional terror attacks, the combination of multiple mechanisms of injury leads to patients sustaining *multidimensional trauma.* Multidimensional trauma is trauma caused by multiple mechanisms resulting in a diverse pattern of injuries (for example: thermal injuries, blast injuries, high velocity penetrating injuries and blunt force trauma combined) all seen in one patient as a result of an explosive type terror attack. These are rare injury patterns when compared to polytrauma (the multisystem trauma that orthopaedic surgeons should see more commonly in their training and practice in South Africa). *Multidimensional* injuries require multiple surgical specialities to stabilise and treat them at times simultaneously (8).

The literature on Orthopaedic Terror Medicine is scarce. There are no existing publications which aim to assess hospital readiness to deal with a terrorist attack. No publications have made use of a questionnaire to assess perceived readiness for multidimensional trauma victims of a terrorist attack.

Background: Orthopaedic injuries in terror attacks

Conventional Terrorist attacks (including explosive attacks) remain the most common type of terror seen over the past decades (1). In a study by Weil *et al*., 85 injured patients sustained a total of 113 long bone fractures. Of those injured, 36% sustained multiple fractures and 43% sustained significant associated injuries (9). Attacks in which explosives were used have been linked to a mechanism-specific traumatic limb amputation pattern unique to terror attacks (10). This is described by Weil *et al*. (9) who showed that orthopeadic injuries sustained after a blast terrorist attack are more severe compared to other violent injury patterns such as gunshot injuries (11).

South African orthopaedic surgeons can also obtain blast injury experience through civilian blast incidents. South Africa has a vast mining industry (12) and civilian mining blast injury is more common in developing countries (13). There are four categories of blast injuries (Table I), each with distinct aetiologies and medical care implications (1).

Type of blast injury:	**Aetiology of damage:**
Primary Blast Injury	The damage to tissue solely from the passage of the blast wave through the patient.
Secondary Blast Injury	The damage sustained from shrapnel (debris and fragmentation) set in motion by the blast wave.
Tertiary Blast Injury	The damage sustained from the body being thrown against other objects by the blast wave or vice-versa.
Quaternary Blast Injury	The damage sustained by the indirect consequences of the blast (thermal burns and structural collapse).

Table I: Description of the types of blast injuries and their aetiology of damage

The combination of the above (Table I) blast injuries creates *multidimensional trauma (multi-mechanism trauma as opposed to 'multi-system trauma' seen in 'polytrauma'*). Skeletal and soft tissue damage is most commonly the result of secondary blast injuries and can account for up to eighty percent of surgical procedures in terror attack survivors (14).

Hospital protocols for a terrorist attack

It is a World Health Organisation (WHO) international standard (15) that every hospital should have a Mass Casualty Incident (MCI) plan for an internal (for example: fire, flooding and structural collapse) and external MCI (for example: a train accident, building collapse,

as well as a terrorist attack). These MCI plans should be practiced on a regular basis to maintain a state of readiness (15-18). The value of this can be seen in a number of relatively recent terrorist attacks whereby the involved hospitals had simulated training scenarios within days of the actual attack taking place.

At the Boston Marathon Bombing (19), nearby hospitals were already on a higher level of readiness for a possible incident because of the Marathon and were thus able to activate additional pre-determined resources when the bombing occurred (20). In the San Bernadeno attack (2015), a hospital based simulated training exercise of a terrorist attack had been recently undertaken, thus allowing for a realistic actual re-enactment when the attack occurred (21). Likewise, the Paris attacks occurred on the same day as a city-wide drill was held to test readiness and response capabilities to deal with a terrorist attack (22). These three incidents reiterate the importance of developing, testing and training a terror-attack specific response as part of the hospital's MCI plan.

Johannesburg hospitals are divided into Public and Private hospitals. Although our hospitals traditionally deal with high levels of trauma, the author to date is unaware of any specific disaster protocols or training related to multidimensional explosive trauma in the Johannesburg area. In particular, the scope and magnitude of orthopaedic injuries may potentially exceed the capabilities of the resources.

Study Aim

This study is aimed at determining the perceived state of readiness of Johannesburg hospitals in dealing with the orthopaedic injuries sustained in an explosive type terrorist attack by analysing the opinions of a sample of specialist orthopaedic surgeons through a questionnaire.

Methodology

Research Design

This was a descriptive, qualitative and quantitative, prospective study making use of a questionnaire.

Materials and Methods

Ethical approval was granted by the Human Research Ethics Council – University of the Witwatersrand (HREC - WITS)(Medical) to distribute the author's questionnaire. The questionnaire consisted of 42 questions covering a wide range of topics related to multidimensional trauma and the possible requirements of the healthcare providing facility. The questionnaire was distributed to 101 orthopaedic surgeons working at both public and private hospitals in the greater Johannesburg area (23). The respondents completed the questionnaire concerning their hospitals' perceived state of readiness to cope with multidimensional injuries from a terror attack.

Data Collection

The questionnaire was either hand delivered and collected (seven respondents), emailed as a PDF, completed and returned (three respondents) or emailed as a link to an online questionnaire (twenty-nine respondents).

Data Analysis

Descriptive analysis of all question responses was undertaken and the responses between public and private hospitals were compared.

Data analysis was carried out using Stata® 15.1 (Statsoft, Palo Alta, California) for Windows® (Microsoft®, Redmond). The X^2 test (24) was used to assess the relationships between hospital sector and questionnaire responses. The Fisher's exact test (25) was used for 2 x 2 tables or where the requirements for the X^2 test could not be met. The strength of

the associations was measured by Cramer's V and the phi coefficient, respectively (24, 25). A p-value of <0.05 was considered statistically relevant.

Results

We contacted 101 orthopaedic surgeons from 17 hospitals to partake in this study. A response rate of 39% (n=39) from 13 hospitals was received. Of the 39 orthopaedic surgeons who participated in the study, 22 completed the questionnaire from the private sector and 17 from the public sector.

Table II shows the breakdown in answers to the questions relevant to orthopaedic surgeons and their role in managing multidimensional trauma. A p value <0.05 shows a statistically significant difference in comparing the hospital sector (public and private).

We found the following questions showed a significant difference between public and private:

There was a significant, strong association with hospital sector (p=0.0049; Cramer's V=0.52): 53% of respondents from state hospitals reported preparedness, compared to only 9% from private hospitals.

There was a significant, moderate association with hospital sector (p=0.031; Cramer's V=0.42): 10 of 17 (59%) of state respondents reported having a standby protocol (whereby additional orthopaedic surgeons can be activated on site in the event of an MCI), compared to only 4 of 22 (18%) from private hospitals. Twelve of 39 (31%) of total respondents felt they were able to activate seven or more additional personnel within an hour in the event of an MCI.

The availability of 24-hour trauma surgeons was higher in state hospitals 15 of 17 (88%) compared to private hospitals 11 of 22 (50%) (p=0.013; phi=0.40; moderate effect size). The availability of a 24-hour anaesthetic service was higher in state hospitals 17 of 17 (100%) compared to private hospitals 14 of 22 (64%) (p=0.0056; phi=0.45; moderate effect size).

The availability of multiple trauma orthopaedic sets was higher in state hospitals, 14 of 17 (82%) compared to private hospitals, 8 of 22 (36%) (p=0.0083; phi=0.46; moderate effect size). In terms of access to multiple external fixator devices, there was a significant, strong association with hospital sector (p=0.0009; Cramer's V=0.60): n=14 (82%) of respondents from state hospitals reported having these devices available, compared to only 5 (23%) from private hospitals. The number of sets available was also strongly associated with hospital sector (p=0.0017; Cramer's V=0.60): 59% of state hospitals had 1-3 sets available, compared to only 14% of private hospitals.

When asked if there was 'an established hierarchy in the event of a MCI' there was a significant, moderate association with the hospital sector (p=0.018; Cramer's V=0.45): 6 of 17 (35%) of respondents from state hospitals reported having an established hierarchy, compared to only 1 of 22 (5%) from private hospitals.

There was a significant, strong association with the hospital group (p=0.005; Cramer's V=0.62): state hospitals could manage more critical/priority 1 (P1) patients compared to private hospitals.

		Overall	Private	State	*p-value for between-group comparison*
Question	**Response**	**n**	**n**	**n**	
n		**39**	**22**	**17**	
Do you work at a private or state hospital?	Private	**22**			
	State	**17**			
Does your hospital have a Mass Casualty Incident (MCI) protocol?	Yes	**9**	**3**	**6**	p=0.280
	No	**8**	**5**	**3**	
	Do not know	**22**	**14**	**8**	
Is there a specific protocol for receiving victims of a suspected explosive type terrorist attack?	Yes	**2**	**1**	**1**	p=0.620
	No	**13**	**6**	**7**	
	Do not know	**24**	**15**	**9**	

Was a MCI practised at your hospital?	Yes	**5**			
	No	**32**			
	Do not know	**2**			
Does your Emergency Department have an additional stock capacity for a MCI?	Yes	**3**	**2**	**1**	p=0.150
	No	**10**	**3**	**7**	
	Do not know	**26**	**17**	**9**	
Do you have a “call-in” (standby) protocol to bring additional personnel from home to assist in the event of a MCI?	Yes	**14**	**4**	**10**	p=0.031 V=0.42
	No	**13**	**9**	**4**	
	Do not know	**12**	**9**	**3**	
Do you have access to 24-hour trauma surgeons?	Yes	**26**	**11**	**15**	p=0.013 phi=0.40

	No	**13**	**11**	**2**	
	Do not know	**0**			
Do you have access to 24-hour general surgeons?	Yes	**38**	**21**	**17**	p>0.990
	No	**1**	**1**	**0**	
	Do not know	**0**			
Do you have access to 24-hour orthopaedic surgeons?	Yes	**38**	**21**	**17**	p>0.990
	No	**1**	**1**	**0**	
	Do not know	**0**			
Do you have access to a 24-hour anaesthetic service?	Yes	**31**	**14**	**17**	p=0.0056 phi=0.45
	No	**8**	**8**	**0**	
	Do not know	**0**			

Do you have access to a 24-hour emergency theatre?	Yes	**35**	**20**	**15**	p>0.990
	No	**4**	**2**	**2**	
	Do not know	**0**			
Do you have access to portable fluoroscopy?	Yes	**39**	**22**	**17**	
	No	**0**			
	Do not know	**0**			
Do you have access to trauma orthopaedic sets on consignment?	Yes	**22**	**8**	**14**	p=0.0083 phi=0.46
	No	**17**	**14**	**3**	
	Do not know	**0**			
Do you have access to multiple external fixator devices on consignment?	Yes	**19**	**5**	**14**	p=0.0009 phi=0.60

	No	**17**	**14**	**3**	
	Do not know	**3**	**3**	**0**	
Are your orthopaedic surgeons willing to operate with other disciplines on the same patient at the same time as required?	Yes	**38**	**21**	**17**	p>0.990
	No	**0**	**0**	**0**	
	Do not know	**1**	**1**	**0**	
Does your hospital keep emergency blood products (12 or more products) on site?	Yes	**22**	**5**	**17**	p<0.0001 V=0.77
	No	**12**	**12**	**0**	
	Do not know	**5**	**5**	**0**	
Does your hospital have a 24-hour blood bank on site?	Yes	**20**	**3**	**17**	p<0.0001 phi=0.86
	No	**19**	**19**	**0**	

	Do not know	**0**			
Does your hospital have an Intensive Care Unit (ICU)?	Yes	**38**	**21**	**17**	p>0.990
	No	**1**	**1**	**0**	
	Do not know	**0**			
Does your hospital have a high care area (HCA)?	Yes	**37**	**20**	**17**	p=0.50
	No	**2**	**2**	**0**	
	Do not know	**0**			
Does your orthopaedic department have an established hierarchy in the event of a MCI?	Yes	**7**	**1**	**6**	p=0.018 V=0.45
	No	**25**	**18**	**7**	
	Do not know	**7**	**3**	**4**	

Do you have experience with working on patients who have tourniquets applied prior to arrival at your hospital?	Yes	**22**	**11**	**11**	p=0.52
	No	**17**	**11**	**6**	
	Do not know	**0**			
Have you ever been exposed to explosive type orthopaedic injures before?	Yes	**27**	**18**	**9**	p=0.082
	No	**12**	**4**	**8**	
	Do not know	**0**			
Are you up to date with explosive type orthopaedic injury management?	Yes	**20**	**11**	**9**	p>0.990
	No	**19**	**11**	**8**	
	Do not know	**0**			

Do you know what the term ‘multi-dimensional’ trauma is as opposed to ‘polytrauma’?	Yes	**19**	**10**	**9**	p=0.750
	No	**20**	**12**	**8**	
	Do not know	**0**			
How many critical patients (P1) do you think you could manage in the event of a terror attack?	None	**4**	**4**	**0**	p=0.0050 V=0.62
	1-5	**20**	**15**	**5**	
	6-10	**7**	**1**	**6**	
	11 or more	**6**	**1**	**5**	
	Do not know	**2**	**1**	**1**	

Table II: Relevant questionnaire data

Discussion

The study aimed to assess the state of preparedness of participating public and private hospitals in the greater Johannesburg area to deal with the orthopaedic injuries sustained in an explosive type terrorist attack. Thirty-nine orthopaedic surgeons across 13 hospitals answered the study questionnaire.

MCI preparation

The data shows that orthopaedic surgeons working in public hospitals feel more prepared to cope with an MCI compared to those working in private hospitals. The majority of public respondents (n=9 of 17) felt their hospitals were prepared to deal with an MCI compared to the minority of public respondents (n=2 of 22). The public sector generally benefits from large facilities, staff and may have additional stock available in stores (26).

With only n=2 of 39 total respondents reporting a dedicated SOP for receiving the victims of an explosive type terrorist attack, there is a need for action. A pre-determined plan (a Terror Medicine orientated Hospital Mass Casualty response plan) (8, 9) and orderly approach is essential to activate all resources in such an event (11, 14). The experiences of orthopaedic departments (4, 7, 27) receiving an influx of terror attack victims continue to emphasise that it is every hospital's responsibility to prepare for such a scenario (1, 28).

Access to emergency theatre and services

The 24-hour access to general surgeons and orthopaedic surgeons was almost identical in public and private hospitals with n=38 of 39 (97%) total respondents reporting such availability. Both the availability of 24-hour trauma surgeons and anaesthetic teams was higher in public hospitals n=15 of 17 (88% trauma surgeon access) and n=17 of 17 (100% anaesthetic service) compared to private hospitals n=11 of 22 (50% trauma surgeon access) and n=14 of 22 (64% anaesthetic services).

Some studies have described orthopaedic injuries as the major reason for surgical treatment after terror-related blast attacks in the civilian and military environments, accounting for 40-70% of all cases requiring surgical intervention (4, 29-31). The discrepancy between public and private hospitals emphasises the need for dedicated hospitals with the capabilities to deal with terror victims and the associated injury patterns. By establishing a pre-determined plan, EMS will transport surgical patients to appropriate facilities where appropriate services are available and adequate care rendered.

Adjunct resources

The availability of multiple trauma orthopaedic sets was higher in public hospitals n=14 of 17 (82%) compared to private hospitals n= 8 of 22 (36%) (p=0.0083; phi=0.46; moderate effect size). Of note, n=17 of 39 (44%) reported that no trauma sets were readily available. Regarding access to multiple external fixator devices, there was a significant, strong association with hospital sector (p=0.0009; Cramer's V=0.60): n=14 of 17 (82%) of respondents from public hospitals reported having these devices available, compared to only n=5 of 22 (23%) from private hospitals.

In terms of blood product accessibility on site, n=17 of 17(100%) of public compared to only n=5 of 22 (23%) of private respondents reported that their hospital kept 12 or more blood products on site. The lack of available trauma sets and more importantly, external fixator devices and high volume blood products may identify a current deficiency in our private hospitals in terms of a terrorist attack MCI plan. After the Boston Marathon Bombing (2013), one of the key actions taken by five orthopaedic departments that had received 124 patients was to increase the number of readily available external fixator devices to provide temporising care to a large number of patients, as well as higher volumes of stored on site blood products (19). Given the shortages of blood products in Sub-Saharan Africa (32), increasing blood product availability presents a larger scale problem than simply ordering more stock.

Key results in this section also include the overall willingness of n=38 of 39 (97%) of total respondents to operate with other disciplines on a patient concurrently. The fundamental nature of multidimensional trauma requires a multi-disciplinary approach (1), at times concurrently, in order to provide damage control intervention as well as improved limb salvage outcomes (27).

MCI Administration

With only n=6 of 17 public respondents and n=1 of 22 private respondents reporting that there is an established hierarchy of staff and decision makers in the event of a terror-related MCI, there is a need to establish a pre-determined plan. Recommendations that the most senior trauma surgeons, emergency medicine physicians and orthopaedic surgeons are directly involved in triage and co-ordination of inter and intra-hospital disciplines is well documented in the literature.

Positively, n= 24 of 39 (62%) were confident that their hospital facility could be locked-down by security personnel if necessary. There has been an increasing trend in targeting hospitals as a primary or secondary attack site (following an initial terrorist attack at another location) (33, 34). The need to be able to lock down a facility and protect staff, patients and visitors is an essential element of the hospital MCI plan (21, 34).

In order to activate all the necessary services required in a rapid manner (11, 14), there is a need for a pre-determined Terror Medicine orientated Hospital Mass Casualty response plan (8, 9). This plan will need to be developed specifically by each hospital for its own application *via* a disaster planning committee. This plan requires a documented chain of command, with defined roles and responsibilities. Each role must have its own clear set of objectives and should be position based rather than personality based (i.e. the most senior doctor in the Emergency Department will be the triage officer, rather than the Emergency Department's head of department (HOD)). The plan should incorporate established and tested protocols (20) and implement a disciplined collaborative approach in order to achieve optimal

standards of patient care (4). The plan must be rehearsed and tested as often as feasible so that all hospital staff are current and understand their roles when the plan is activated.

Surgical capabilities

The South African orthopaedic surgeon has likely been exposed to a significant volume of trauma in their training and/or practice (35, 36). In terms of managing patients who have had a tourniquet applied in pre-hospital environment, prior to their arrival, n=22 of 39 (56%) of total respondents reported having experience in managing such patients, a scenario which may necessitate additional training (37, 38).

Given the large trauma burden (35, 36) in South Africa and the additional resources available in public facilities to cope with larger numbers of concurrent patients, it is largely expected that public hospitals could manage more critical/priority 1 (P1) patients compared to private hospitals.

Interestingly, with regards to explosive type orthopaedic injuries, n=27 of 39 (69%) of total respondents had exposure to explosive type orthopaedic injuries and n=20 of 39 (51%) felt that they were current with the latest management strategies. Terrorist attacks against a civilian target affects a broad spectrum of the population ranging from children to the elderly. The absence of body armour increases the incidence of penetrating thoraco-abdominal injuries in addition to the devastating limb injuries. The result is, a combination of blast-specific and multiple-mechanism (multidimensional) injuries in an unprotected population (9, 14). With half (n=19 of 39 (49%)) of respondents knowing the difference between ‘multidimensional’ trauma as opposed to ‘polytrauma’ there is a need for further training/exposure. The goal of terror medicine education is to improve patient outcomes in both predicted and unpredicted scenarios (1). University medical schools in several countries have run short elective courses in terror medicine with positive results and an enthusiastic response (1, 18, 39).

Recommendations

A national assessment of hospital preparedness is recommended. As well, the development of a Terror-medicine course that is offered at a post-graduate level is encouraged.

Limitations

Limitations include the limited response from respondents (39 of 101) from 13 of the 17 hospitals included although there are a number of orthopaedic surgeons who do not do trauma work and therefore may have felt that they could not contribute to this body of knowledge. Additionally, a national survey would be of greater benefit to assess the state of preparedness in order to implement a more global response to any deficits identified. We however felt that we wanted to start by understanding our environment. The questionnaire represents a subjective opinion of the orthopaedic surgeons in their respective hospitals. There will inevitably be bias in a questionnaire of this nature (40).

Conclusion

Johannesburg hospitals have a variable amount of experience with dealing with trauma patients. A hospital response plan to a terrorist attack differs from a normal disaster management plan due to the nature of the injuries sustained (multidimensional trauma) and the security element (given the risk for additional attacks which place the hospital staff and patients at an increased risk). There is an essential and urgent need for South African hospitals to develop hospital specific terrorist attack mass casualty response protocols.

We recommend that given the *multidimensional trauma* seen in conventional terrorist attacks, which adds further complexity to the trauma patient and trauma management system, there is a need for additional training or exposure (through education) to the management of multiple-mechanism, multisystem trauma that may require concurrent multidisciplinary management and surgical intervention.

The study results suggest that public hospitals appear to have access to higher numbers of staff and theoretically, more readily available equipment compared to private hospitals. In the event of a terrorist MCI, there will be a need for a well-established public/private hospital partnership.

Ethics statement

Ethical approval was granted by the Human Research Ethics Council – University of the Witwatersrand (HREC - WITS)(Medical) to proceed with the study (clearance certificate: M171012)

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Appendices

Appendix A: Research Protocol

Research Protocol

Orthopaedic Terror Medicine:

Johannesburg Hospitals' preparations for orthopaedic injuries from a terrorist attack.

Dr A. Hirschmann

Orthopaedic Registrar

MMed (Ortho) Student

(University of the Witwatersrand, Johannesburg)

Student Number: 0213985A

Table of Contents:

List of Abbreviations

CEO…… Chief Executive Officer

EM……..…Emergency Medicine

EMS……..Emergency Medical Services

HREC…….Human Research Ethics Committee

IED…….Improvised Explosive Device

PAGAD…….People Against Gangsterism and Drugs

SA……..….South Africa

TM………..…….. Terror Medicine

1. Introduction and literature review

1.1 Background

Terrorism has been defined as “the calculated use of unlawful violence or threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious, or ideological”(1). International terrorism claimed 28328 lives in 2015, injuring 35320 (2). The scale of incidents has, through necessity, given birth to a new branch of Emergency Medicine called *Terror Medicine* (4, 5).

Given that five of the leading ten countries worldwide with the highest number of fatalities from terror events in 2015 are located on the African continent, South Africa (SA) is potentially at risk. Three of the most active terrorist organisations (two are present in sub-Saharan Africa), currently openly promote and accomplish attacks in western countries (1). In 2000, SA faced an incident, considered as terrorist in motivation, in which an Improvised Explosive Device (IED) was detonated against the civilian population by the Cape Town People Against Gangsterism and Drugs (PAGAD) (5). More recently, there have been numerous instances where petrol bombs have been used in violent protests(41, 42). Emergency Medical Services (EMS), emergency doctors and surgeons (4, 5) obtained significant operational experience during the explosive attack incidents of the early nineteen ninety’s and that of PAGAD within the same decade. However, international terrorism has evolved in its methods of creating terror and grown substantially (1).

SA is the fifteenth lowest country in the world in terms of safety and security (35), and the eighth most violent, with a murder rate of thirty one per one hundred thousand according to the Institute for Economics and Peace (35). In SA, road traffic injuries are double and injury related mortality rates six times higher than the global rates respectively (36). The high rate of trauma in SA has allowed for significant exposure to such injuries and the establishment of Level 1 trauma facilities. Despite the experience obtained from road traffic incidents and violent crime, there has been minimal exposure to blast injuries as seen in explosive detonations used in terrorist attacks.

1.2 Classification of terror attacks

Terror attacks can be classified into either conventional or unconventional (2):

1. *Conventional Terror attacks*: These are made up of multiple mechanisms that cause blunt, penetrating, thermal and blast injuries. The combination of such mechanisms of injury leads to patients sustaining multidimensional trauma, i.e. different classes of injury occurring simultaneously in the same patient. These injuries require multiple surgical specialities to stabilise and treat them (8). *Conventional attacks*: These include stabbings (2) shootings (43), blunt force assault (2), projectile attacks (such as throwing rocks at people or vehicles(1)) improvised explosive attacks (including the suicide bomber (1)), high speed vehicular attacks and attacks on buildings/infrastructure.

   A combination of conventional terror methods has been seen in a number of recent international terror attacks. The relatively recent large-scale Brussels (2016) terror attack that involved three co-ordinated suicide bombings (two at the Zaventem International Airport and one at the Metro rail station in Maalbeek) claimed thirty two civilian lives and injured in excess of three hundred (1, 43). The Turkish Ataruk Airport attack (2016) which is an example of a modality that went further than just an improvised explosive attack. At Ataruk Airport, three attackers armed with automatic firearms and explosive belts killed forty five people and injured in excess of two hundred and thirty (44). The Paris attacks (2015) again showed a multimodal example of a mass terrorist attack. During the Paris attack, nine attackers used fully automatic firearms, hand grenades and explosive suicide vests to attack six different locations (22). They killed one hundred and thirty civilians and injured three hundred and sixty-eight in a combination of mass shootings, explosive attacks, suicide vest detonations and during hostage taking scenarios. The Bastille Day attack in Nice (2016), initiated a new mode of attack (6, 45). During this attack, a nineteen-ton cargo truck was intentionally driven at high speed into a crowded

boulevard of people over a 1.7-kilometre distance, killing eighty-six and injuring four hundred and fifty-eight people.

2. Unconventional terror attacks include:

    a. *Chemical Terror*: utilising chemical agents such as organophosphates e.g. Sarin attack in Tokyo (1995)
    b. *Biological Terror*: the use of contagious (micro-organisms) and non-contagious (toxin) biological agents e.g. Anthrax attacks *via* the postal service in the United States of America (2001)
    c. *Radiological Terror*: using radiation poisoning in either a targeted attack or as a weapon of mass destruction (a radioactive bomb)(1).

1.3 Orthopaedic injuries in terror attacks

Conventional Terrorist attacks remain the most common type of terror seen over the past decades (1). This multi-modal type of terrorism creates significant orthopaedic injuries amongst survivors through a combination of blast, penetrating and blunt force mechanisms (1). In a study by Weil *et al*., 85 injured patients sustained a total of 113 long bone fractures. Of those injured, 36% sustained multiple fractures and 43% sustained significant associated injuries (46). Attacks in which explosives were used have been linked to a mechanism-specific traumatic limb amputation pattern unique to terror attacks (10). This is described by Weil *et al*. (6), who showed that orthopeadic injuries sustained after a blast terrorist attack are more severe compared to other violent injury patterns such as gunshot injuries.

There are four categories of blast injuries, each with distinct aetiologies and medical care implications (1):

1. *Primary Blast Injury*: the damage to tissue solely from the passage of the blast wave through the patient.
2. *Secondary Blast Injury*: the damage sustained from shrapnel (debris and fragmentation) set in motion by the blast wave.
3. *Tertiary Blast Injury*: damage sustained from the body being thrown against other objects by the blast wave or vice-versa
4. *Quaternary Blast Injury*: damage sustained by the indirect consequences of the blast (thermal burns and structural collapse).

The combination of the above blast injuries creates multi-dimensional trauma. Skeletal and soft tissue damage is most commonly the result of secondary blast injuries and can account for up to eighty percent of surgical procedures in terror attack survivors (14).

1.4 Hospital protocols for a terrorist attack

Three recent hospital responses to terrorist attacks were trained and tested within weeks to hours of an attack taking place. In the case of the Boston Marathon Bombing (19), nearby hospitals were on a higher level of readiness for a possible incident and were able to activate additional pre-determined resources as the attack occurred (20). In the San Bernadeno attack (2015), a response plan to a terrorist attack had been developed and recently tested allowing for a clearly defined escalation protocol to handle incoming patients (21). The Paris attacks occurred on the same day as a city-wide drill was held to test readiness and response capabilities to deal with a terrorist attack (22). These three incidents confirm that assessing readiness and making preparations to deal with a mass casualty terrorist attack are an important first step in developing a hospital specific plan which will assist in optimising patient care in such an event.

A pre-determined plan (A Terror Medicine orientated Hospital Mass Casualty response plan) (8, 9) and orderly approach is essential to activate all resources in such an event (11, 14). This plan will need to be developed specifically by each hospital for its own application *via* a disaster planning committee. This plan requires a documented chain of command, with

defined roles and responsibilities. Each role must have its own clear set of objectives and should be position based rather than personality based (i.e. the most senior doctor in the Emergency Department will be the triage officer, rather than the Emergency Dept. head of department (HOD)).The plan should incorporate established and tested protocols (20) and implement a disciplined collaborative approach in order to achieve optimal standards of patient care (4). The plan must be rehearsed and tested as often as feasible so that all hospital staff are current and understand their roles when the plan is activated.

The experiences of Orthopaedic departments (4, 7, 27) that have been exposed to the scenario of receiving an influx of terror attack victims repeatedly emphasise the same sentiment: it is every hospital's responsibility to prepare for such an event (1).

A hospital response plan to a terrorist attack differs from a normal disaster management plan due to the nature of the injuries sustained (multi-dimensional trauma) and the security element (given the risk for additional attacks which place the hospital staff and patients at an increased risk). There is an essential and urgent need for South African hospitals to develop hospital specific terrorist attack mass casualty response protocols.

The literature on Orthopaedic Terror Medicine is scarce. There are no existing publications which aim to assess hospital readiness to deal with a terrorist attack. No publications have made use of a questionnaire to assess perceived readiness for multidimensional trauma victims of a terrorist attack.

1.5 South African resources

The South African healthcare system is comprised of state and the private sector. The state sector generally benefits from large facilities and staff. Due to the high volumes of patients seen at these hospitals, there is often plentiful basic resources and tiered staffing due to the training undertaken at these hospitals (through the process of medical internship and community service).

Private hospitals are generally smaller and more specialised for lower volume patient load. Their staff are primarily consultant specialists with little or no junior staff involvement. Also, nursing care has been optimised in relation to patient volume (a higher ratio of nurses to patients is seen in the private sector) allowing little reserves for immediate response to mass casualty influx (there are fewer nursing staff available to call on in the event of a mass casualty activation).

1.6 Primary Aim

To assess the current state of selected Johannesburg hospitals' preparations in the event of a terrorist attack.

1.7 Secondary Aim

To determine the opinions of a sample of specialist orthopaedic surgeons regarding the preparation of Johannesburg hospitals in dealing with the Orthopaedic injuries sustained in an explosive type terrorist attack.

1.8 Study Objective

To develop and distribute a questionnaire that will assess the opinions of a selection of specialist orthopaedic surgeons regarding Orthopeadic departments' readiness to deal with the consequences, patient volume and extent of injuries sustained in an explosive type terrorist attack at Johannesburg Hospitals.

2 Material and Methods

2.1 Study design

This is a descriptive, qualitative and quantitative, prospective study making use of a questionnaire.

2.2 Study site

The greater Johannesburg area as defined by the Gauteng Department of Health.

2.3 Study population

Senior Orthopaedic surgeons (In state and private hospitals listed in Appendix D) and Chief Executive Officers (in state hospitals listed in Appendix D).

2.4 Data Collection

A questionnaire will be prepared using the current literature (Appendix B). This will be distributed by the researcher once ethical approval is obtained from Human Research Ethics Committee (HREC) (Medical), directly to a selection of specialist orthopaedic surgeons (in state and private hospitals listed in Appendix D) and Chief Executive Officers (CEOs) (in state hospitals) working in the Johannesburg hospitals. The questionnaire includes a demographic component as well as questions about their opinions regarding the preparedness of their hospitals. Participants will be asked to select the most applicable answer from given categories, and when necessary will be provided with space to add additional comments.

i) A questionnaire will be delivered to:

i. A specialist orthopaedic surgeon who works at a state hospital by prior arrangement (telephonically or by email) and a CEO (at state hospitals)
ii. A specialist orthopaedic surgeon who works at a private hospital (by personal appointment, or prior arrangement by telephone/email at their private practice).

ii) The questionnaire will be delivered to the participant, who will complete it, by the researcher personally or electronically, by prior arrangement. The information sheet, study control sheet and questionnaire will be handed over at this appointment or electronically by email (Appendix A). The participant responsible for completing the questionnaire will have the opportunity to ask any questions to the researcher at this time. The questionnaire should be completed in a private

and comfortable room. Contact details of the researcher as well as the HREC will be provided on the information sheet. Once completed, the questionnaire will be collected by prior arrangement. The questionnaire will be completed in a private room and comfortable environment.

iii) A study control sheet will be completed by the person who answers the questionnaire. The study control sheet will be kept separately to the questionnaire at all times. The study control sheet will contain a reference number which will be duplicated on the questionnaire. It will also contain a hospital study code to maintain hospital anonymity.

iv) A questionnaire that has been approved by the HREC (Medical) will be circulated to the relevant parties with clear instructions of how it should be completed. Once completed, the results will be audited and reported on. A sealable envelope will be provided at the time of collection.

v) All questionnaires and study control sheets will be kept separately in a locked and secure cabinet in a private location. Only the researchers will have knowledge of the whereabouts and access to the keys that unlock these cabinets.

vi) What interventions are to be made?

There are no medical interventions to be made.

vii) Describe measurements of outcome in detail so that outsider can interpret the results

i. The presence or absence of trauma orthopaedic cover will be noted
ii. Completed questionnaires will be audited and the results analysed.

iii. Failure to complete a questionnaire will be reviewed as answering “No” to the question of willingness to partake in the study.

iv. All answered questions will be included in data collection.

viii) State the endpoints for the study

Participants will be given a one-week period in which to complete the questionnaire once delivered. State hospital CEOs will be given a 3-month period to reply if they will allow the questionnaire to be distributed to Orthopaedic Surgeons working in their hospitals. A reminder will be provided three days after the questionnaire has been delivered as a follow-up courtesy either telephonically or by email.

ix) Bias: The researcher has compiled a questionnaire based on the literature reviewed and currently available. Given that this type of study has not been performed before, there are no published questionnaires to compare to. Every effort to avoid researcher bias will be adhered to by applying data analysis regulations.

x) Will a pilot study be necessary?

The questionnaire will be piloted on five Orthopaedic surgeons prior to distribution for this study.

i. **Inclusion criteria**

i. Senior Orthopaedic surgeons who have a practice at a Private hospital in the greater Johannesburg area or who work in a State hospital in the greater Johannesburg area will be approached for participation.

ii. Hospitals must have a 24-hour Emergency Department and/or a 24-hour transfer procedure (so there is access for emergency patients to be admitted to the hospital at all times of day).
iii. Participants must consent to completing the questionnaire

ii. **Exclusion criteria**

Hospitals falling outside the defined area of study

3. Data analysis

The data from the survey will be captured on an Excel® spreadsheet (Microsoft Office 365®, Redmond) and analysed using STATISTICA® software (Statsoft, Palo Alta, California). Descriptive analysis of all the data will be carried out by frequency and percentage tabulation. The results will be illustrated by means of bar charts. A qualitative and quantitative comparison of the results between public and private hospitals will be carried out.

4. Ethics

The protocol has been submitted (4 October 2017) to the Human Research Ethics Committee (Medical) of the University of Witwatersrand for approval.

5. Timing

	Oct 2017	Nov 2017	Dec 2017	Mar 2020	Aug 2020	Sep 2020	Oct 2020	Oct 2020	Nov 2020	Dec 2021
Protocol Submission										
Ethics Submission										
Protocol Approval										
Protocol Amendments										
Ethics Approval										
Data Collection				COVID	DELAY					
Data Analysis						COVID	DELAY			
Report/ Submission								COVID	DELAY	

6. Funding

All administrative costs will be carried by the researcher. A total estimate of R 5000.00 for printing, transport, telephonic use and data collection has been made.

Item	Cost
Printing	R1500
Transport	R2500
Telephone	R1000
Total	R5000

7. Anticipated Problems

The researchers expect that some participants will not complete the questionnaire. Possible confounding variables such as logistical limitations: participants on leave, language barriers or technological failures will be addressed as they occur.

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Appendix B: WITS HREC (Medical) Clearance Certificate:

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Dr A Hirschmann

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M171012

NAME: (Principal Investigator)	Dr A Hirschmann
DEPARTMENT:	School of Clinical Medicine Department of Surgery Division of Orthopaedic Surgery Medical School University
PROJECT TITLE:	Orthopaedic terror medicine: Johannesburg hospitals' preparations for orthopaedic injuries from a terrorist attack
DATE CONSIDERED:	27/10/2017
DECISION:	Approved unconditionally
CONDITIONS:	Approval applies to those study sites listed in Annex 1 to this Clearance Certificate Other sites may be added on receipt by the HREC (Med) of evidence of management approval
SUPERVISOR:	Dr B Gelbart
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	01/08/2018

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. I agree to submit a yearly progress report. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **«Missing mail merge field»** and therefore reports and re-certification will be due in the month of **«Missing mail merge field»** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

14/12/2020
Date

Appendix C: <u>List of greater Johannesburg area hospitals:</u>

Public:

1. Charlotte Maxeke Johannesburg Academic Hospital
2. Chris Hani Baragwanath Hospital
3. Helen Joseph Hospital
4. Leratong Hospital
5. Edenvale hospital
6. Tambo Memorial Hospital
7. Thelle Mogoerane
8. Sebokeng Hospital

Private:

9. Life Bedford Gardens Hospital
10. Life Brenthurst Clinic
11. Life Carstenhof Clinic
12. Life Flora Clinic
13. Garden City Clinic
14. Lesedi Hospital
15. Netcare Linksfield Park Clinic
16. Milpark Hospital
17. Morningside Medi-Clinic
18. Netcare Mulbarton Hospital
19. Netcare Olivedale Clinic
20. Netcare Park Lane Clinic
21. Netcare Rand Clinic

22. Life Roseacres Clinic
23. Netcare Linmed
24. Rosebank Clinic
25. Sandton Medi-Clinic
26. Netcare Sunninghill Hospital
27. Netcare Union Hospital
28. Life Wilgeheuwel Hospital
29. Wits University Donald Gordon Medical Centre
30. Life Fourways Hospital

Appendix D: Questionnaire

Johannesburg Hospitals' preparations for orthopaedic injuries from a terrorist attack

Orthopaedic Terror Medicine questionnaire

Study Reference number: _____

Hospital study code:_____

*Thank you for taking the time to complete this questionnaire. Please mark your selected answer with an "***X***".*

Please note that the name of your hospital will not be documented for research purposes nor shared with anyone – it is only to avoid duplicate information per facility.

_____

1	What is your position?	Senior consultant:	Other (please state):		
2	Do you feel that your department/hospital is equipped to deal with multiple casualties from a suspected explosive type terrorist attack?	Yes:	No:	Don't know:	
3	Do you work at a private or state hospital?	Private:	State:		
4	What level of accreditation is your hospital as a trauma centre?	Level 1:	Level 2:	Level 3:	Don't know:

5	Does your hospital have a mass casualty incident (MCI) protocol?	Yes:	No:	Don't Know:	
6	Is there a specific protocol for receiving victims of a suspected explosive type terrorist attack?	Yes:	No:	Don't Know:	
7	When last was the MCI protocol practiced?	0-6 months:	6-12 months:	Never:	Don't know:
8	Are all the doctors in your Emergency Department Advanced Trauma Life Support (ATLS™) certified?	Yes:	No:	Don't know:	
9	Does your Emergency Department have an additional stock capacity for a MCI?	Yes:	No:	Don't know:	
10	Do you have a "call-in" (standby) protocol to bring additional personnel from home to assist in the event of a MCI?	Yes:	No:	Don't know:	
11	Do you have access to 24-hour trauma surgeons?	Yes:	No:	Don't know:	
12	Do you have access to 24-hour general surgeons?	Yes:	No:	Don't know:	
13	Do you have access to 24-hour orthopaedic surgeons?	Yes:	No:	Don't know:	
14	How many orthopaedic surgery staff can be on site within 1 hour in response to a Mass Casualty Incident?	1-3:	4-6:	7 or more:	Don't know:

15	Do you have access to a 24-hour anaesthetic service?	Yes:	No:	Don't know:	
16	Do you have access to a 24-hour emergency theatre?	Yes:	No:	Don't know:	
17	How many 24-hour emergency theatres can be used in response to a MCI?	1:	2-3:	More than 4:	Don't know:
18	Do you have access to portable fluoroscopy?	Yes:	No:	Don't know:	
19	Do you have access to 24-hour support staff and autoclaves (sterilizing facilities for surgical equipment)?	Yes:	No:	Don't know:	
20	Do you have access to multiple trauma orthopaedic sets on consignment?	Yes:	No:	Don't know:	
21	If you answered "Yes" to the above question, how many sets are available?	1-3 sets:	4-6 sets:	7 or more sets:	Don't know
22	Do you have access to multiple external fixator devices on consignment?	Yes:	No:	Don't know:	
23	If you answered "Yes" to the above question, how many sets are available?	1-3 sets:	4-6 sets:	7 or more sets:	Don't know
24	Are your orthopaedic surgeons willing to operate with other disciplines on the same patient at the same time as required?	Yes:	No:	Don't know:	

25	Does your hospital keep emergency blood products (12 or more products) on site?	Yes:	No:	Don't know:	
26	Does your hospital have a 24-hour blood bank on site?	Yes:	No:	Don't know:	
27	Does your hospital have an Intensive Care Unit (ICU)?	Yes:	No:	Don't know:	
28	How many beds does your hospital ICU have?	1-5:	6-10:	More than 10:	Don't know:
29	Does your hospital have a high care area (HCA)?	Yes:	No:	Don't know:	
30	How many beds does your hospital HCA have?	1-5:	6-10:	More than 10:	Don't know:
31	How many beds can be made readily available for a patient who has sustained multidimensional trauma in your ICU/HCA?	1-5:	6-10:	More than 10:	Don't know:
32	Does your orthopaedic department have an established hierarchy in the event of a MCI?	Yes:	No:	Don't know:	
33	Does your hospital have an established line of communication with the pre-hospital emergency medical services (EMS)?	Yes:	No:	Don't know:	

34	Does your hospital have an established line of communication between transferring hospitals in your area?	Yes:	No:	Don't know:	
35	Does your hospital have 24-hour security on site?	Yes:	No:	Don't know:	
36	Can access to your hospital facility be strictly controlled and locked down if necessary?	Yes:	No:	Don't know:	
37	Does your hospital have an emergency radiology service (24-hour cover and the ability to call-in more staff if necessary)?	Yes:	No:	Don't know:	
38	Do you have experience with working on patients who have tourniquets applied prior to arrival at your hospital?	Yes:	No:	Don't know:	
39	How many critical patients (P1) do you think you could manage in the event of a terror attack?	None:	1-5:	6-10:	More than 10:
40	Have you ever been exposed to explosive type orthopaedic injures before?	Yes:	No:	Don't know:	
41	Are you up to date with explosive type orthopaedic injury management?	Yes:	No:	Don't know:	

Thank you for taking the time to complete this questionnaire.

Study Reference number: _____

Appendix E: Participant Information Sheet

Orthopaedic Terror Medicine:

Johannesburg Hospitals' preparations for orthopaedic injuries from a terrorist attack

Hello

My name is Adam Hirschmann and I am a registrar in Orthopaedic Surgery at the University of Witwatersrand. As part of my MMed degree I am assessing the preparations of hospitals in the greater Johannesburg area to deal with the orthopaedic injuries sustained in an explosive type terrorist attack.

I would greatly appreciate your help if you would be willing to please assist me by completing a short questionnaire which should take you approximately 10 minutes to complete.

Why are we doing this? Experience has shown that the injuries sustained in an explosive type terrorist attack are multidimensional and require a unique multidisciplinary approach. Hospitals may have to cope with massive influx of patients and be prepared for the unique scope of injuries seen. I wish to assess, without prejudice, the state of preparedness of the hospitals in Johannesburg. The information from this study will be blinded to everyone except the researchers.

What do we expect from the participants in the study? I would like you to answer a questionnaire. The questionnaire is designed to broadly assess your perception of the current level of preparation to deal with a terrorist attack at your hospital.

There are no direct benefits to participants partaking in this study.

You may withdraw from the study at any time without having to give a reason. Remember that this study is completely voluntary.

If you have any queries, more information may be obtained from me directly at telephone number 082 567 8407 or email address: adamhmann@gmail.com. This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg. The Chairperson of this Committee is Professor Clement Penny, who may be contacted on telephone number 011 717 2301 or by e-mail on clement.penny@wits.ac.za . The telephone numbers for the Committee secretary are 011 717

2700/2656/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za; and Lebo.Moeng@wits.ac.za

Thank you for reading this document and considering my request.

Regards

Dr A. Hirschmann

Appendix F: Study control sheet

Orthopaedic Terror Medicine:

Johannesburg Hospitals' preparations for orthopaedic injuries from a terrorist attack.

Study control sheet:

Study reference number: _____

Hospital study code: _____

Contact details:

Email address: _____

Telephone contact: _____

Hospital: _____

Appendix G: South African Orthopaedic Journal (SAOJ) guidelines:

Abstract

A structured abstract (maximum of 350 words), summarising the most important points in the article is required.

The abstract consisting of four paragraphs with the subheadings:

- Background (must include the aim of the study)
- Patients and methods
- Results
- Conclusion

References should be avoided. Avoid uncommon abbreviations. If essential they must be defined at their first mention in the abstract itself

Keywords

Immediately after the abstract, provide a maximum of 6 keywords, using standard searchable terms. These keywords will be used for indexing purposes.

Level of evidence

Level 1 to 5.

Please follow the level of evidence guidelines provided by the Oxford Centre for Evidence-Based Medicine (OCEBM); version 2.1.

Available from: OCEBM Levels of Evidence Working Group. “The Oxford Levels of Evidence 2”.Oxford Centre for Evidence-Based Medicine. http://www.cebm.net/index.aspx?o=5653

Introduction

The introduction should contextualise the study by providing the background to the research; explain the problem that is to be addressed and provide the rationale for the study.

Briefly outline the relevance if the study in respect to the current literature. Avoid a detailed literature survey or a summary of the results.

The last sentence should outline the research question or hypothesis.

Patients (or Materials) and Methods

State the methods, outcome measures, and selection criteria. The following aspects needs to be described:

- The study design and research methodology.
- Whether randomization (with methods) was applied.
- If case controlled, how the controls were selected.
- The time period under review.
- Number of patients/subjects under investigation and why this number was chosen.
- Inclusion and exclusion criteria.
- Case and outcome definitions.
- Description of procedure or intervention, including post-operative protocol.
- The outcome measures or scores were used.
- The minimum follow-up period.
- A statistical analysis section should be included at the end of this section to detail statistical tests and package used, the reasons why these tests were used, and what p-value was considered statistically significant. A power analysis is recommended for studies comparing two or more groups.
- Provide sufficient detail so that another researcher can replicate the study.
- The reader should understand from this description all potential sources of bias such as referral, diagnosis, exclusion, recall, or treatment bias. This includes the manner in which investigators selected the patients. Consecutive inclusion implies all patients with a given diagnosis are included, while selective implies patients with a given diagnosis but selected according to certain explicit criteria (e.g. state of disease, choice of treatment).
- Do not describe standard procedure for common operations. Only include new procedures or adaptations to standard procedure.
- If you name any specific product, then it requires the name, city and state/country of the manufacturer.
- Present in narrative format and use past tense.
- Where relevant, tables or figures may be included to provide information more clearly.
- Generally, no data should normally be presented in this section.

Results

- Describe the relevant results and analysis thereof.
- Provide details of the number of patients included and excluded, as well as the reason for exclusion.
- It is important to state the follow-up period (mean and range).
- The results can be broken down into separate sections, e.g. Treatment, Functional outcome, Complications, etc.
- Tables may be used but avoid repeating data reported in the text in the tables.
- All appropriate data should be presented as means with ranges, not with standard deviations (SDs). Medians should only be used when the data is skewed, accompanied by an interquartile range (IQR).
- Avoid using percentages in studies involving well under 100 subjects.
- All results must be backed-up with p-values or survivorship analysis. All Kaplan-Meier data should be presented with the confidence intervals. Always present exact absolute p-values, whether significant or not, unless $p < 0.001$.
- However, p-values do not always convey the entire picture and where relevant the confidence interval will also be required (in addition to the power of the study reported in the methods section).

Discussion

- The question or hypothesis stated at the end of the introduction should be discussed and supported or rejected.
- The results must be interpreted clearly and any deficiencies expressed. All possible confounding factors, sources of bias, weaknesses in the study should be identified.
- Explore the significance of the results of the work, rather than repeating the results.
- The discussion must point out the relevance of the work described in the paper and its contribution to current knowledge.
- Explain what can be deduced from the results and how will it affect clinical practice should be clearly stated
- Should include a review of the relevant literature, placing the results of the study in the context of previous work in this area.
- Discussion of relevant prior research and references must be concise. Avoid extensive citations and discussion of published literature but put emphasis on previous findings that agree (or disagree) with those of the present study.
- Do not repeat the introduction.
- The limitations of the study must be presented and suggest how the study could have been improved for a future study.
- Authors should avoid making inferences from non-significant trends unless they believe their study is adequately powered to answer the question; in that case, provide a power analysis.

Conclusion

Summary statement which conveys the conclusions of the findings. Do not draw conclusions not supported by the data obtained from the specific study presented.

Appendix H: Student's contribution to the research and writing of the "submissible" paper

Division of Orthopaedic Surgery

Faculty of Health Sciences, 4M Room 12, Wits Medical School, 7 York Road, Parktown 2193
• Tel: +27 11 717-2538 • Fax: +27 11 717-2551

05/07/2021

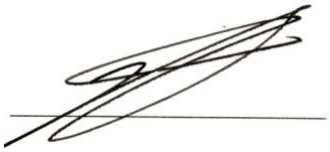
Faculty of Health Sciences, University of the Witwatersrand

RE: ADAM HIRSCHMANN'S CONTRIBUTION TO THE RESEARCH AND WRITING OF THE "SUBMISSIBLE" PAPER

To whom it may concern,

This letter serves to confirm that the co-authors of the "submissible" research paper have agreed to its use by Adam Hirschmann, student number: 0213985A, as part of his MMed research report. Adam Hirschmann made a substantial contribution to conducting the research study and writing the manuscript.

Yours sincerely,



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Dr Brad Gelbart

Primary Supervisor

Dr Adam Hirschmann

MMed Candidate