UNIVERSITY OF CAPE TOWN

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Paediatric Civilian gunshot injuries: A 10-year epidemiological study and Review of Orthopaedic Management

Frances Verfuss

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Supervisors:
Professor Sithombo Maqungo

DECLARATION

Declaration: Student

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This study was conducted from under the supervision of Professor Sithombo Maqungo, Department of Orthopaedic Surgery, University of Cape Town. As the candidate's Supervisor, I have approved this dissertation for submission.

The planned publication meets all requirements to be included in the dissertation, the planned journal is accredited by the department of higher education and training and the candidate is the first author on the paper; the candidate contributed the most to the paper, the candidate developed the protocol and wrote the paper under supervision; the candidate was involved in the analysis, presentation and interpretation of results; the other authors and their contributions to the paper are stated.

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This manuscript is submitted in the publication-ready format. The manuscript is set out according to the instructions for authors for the journal Injury. See Appendix 1. It has not yet been submitted for publication; however, this is the intention.

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Paediatric Civilian gunshot injuries: A 10-year epidemiological study and Review of Orthopaedic Management

Dr Frances Verfuss[a]; Dr Khameela Leyland[b]; Dr Kim Laubscher[a]; Dr Anria Horn[c]; Dr Nisha Jacob[df]; Dr S Dix Peek, [c]Prof Sithombo Maqungo[ef];

a) *MBChB, Registrar Department of Orthopaedics, Groote Schuur Hospital, University of Cape Town, South Africa*
b) *MBChB, Medical Officer Department of Orthopaedics, Livingstone Hospital, South Africa*
c) *Division of Orthopaedic Surgery, Red Cross War Memorial Children's Hospital and Faculty of Health Sciences, University of Cape Town, South Africa*
d) *University of Cape Town (UCT) · School of Public Health and Family Medicine; MBChB; MMed (Public Health Medicine); FCPHM (SA)*
e) *University of Cape Town; MBChB, FC Ortho, MMed, PG Dip HPE, Associate Professor and Head of Clinical Unit: Orthopaedic Trauma Service, Groote Schuur Hospital and University of Cape Town*
f) *Childsafe South Africa*

Corresponding Author

Dr Frances Verfuss

Division of Orthopaedic Surgery

H49 OMB

Groote Schuur Hospital

Observatory 7925

Cape Town - South Africa

Telephone: (-27-21) 406 6157/ 8

Telefax: (-27-21) 447-2709

e-mail: docfv251@gmail.com

CRediT Author Statement

Frances Verfuss: Conceptualization; Data curation; Investigation; Methodology; Roles/Writing - original draft

Khameela Leyland: Roles/Writing - original draft; Data curation

Kim Laubscher: Data curation

Anria Horn: Writing - review & editing

Nisha Jacob: Writing - review & editing

Stewart Dix Peek: Conceptualisation, access to data

Sithombo Maqungo: Conceptualization; Supervision; Writing - review & editing; Project administration

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"Paediatric", "Gunshot", "GSW", "firearm", "children"

Abbreviations

GSW	Gunshot wound
GSH	Groote Schuur Hospital
RXH	Red Cross Children's Hospital
CRE	Carbapenem resistant Enterobacteriaceae
CRIF	Closed Reduction and Internal Fixation
Ex-fix	External Fixation
PACS	Picture Archiving and Communication System
POP	Plaster of Paris
SCI	spinal Cord Injury
TBI	Traumatic brain injury

Abstract

Introduction

In South Africa, the prevalence of violent crime, especially involving firearms, poses a significant public health challenge, particularly when it affects children. Previous studies showed a decrease in paediatric civilian gunshot injuries following the introduction of the 2004 Firearms Control Act. This study examines the epidemiological trends of gunshot injuries in children from January 2011 to December 2020.

Methods

A descriptive cross-sectional study was performed on children aged 0-12 years presenting to the Red Cross War Memorial Children's Hospital (RXH) in Cape Town with gunshot injuries from January 2011 to December 2020. The data were drawn from the ChildSafe database and hospital records. We evaluated demographics, injury specifics, and orthopaedic outcomes.

Results

The number of gunshot wounds(GSW) in the observational record showed an increasing trend of +2.69 (95%CI 1.05 – 4.33) patients per year with a total of 236 patients affected. There was a male predominance (56.8%), with the largest age group affected being children aged 5-9 years (44%). Orthopaedic injuries were prevalent in 69 patients (29.2%), including fractures and injuries to the peripheral nerves and spinal cord. A total of 71 fractures were recorded, with 54 occurring in the extremities and 17 involving the spine or pelvis. The lower extremities were most affected, necessitating surgical interventions such as external fixators and/or femur nails. Peripheral nerve injuries and spinal cord injuries resulted in significant long-term morbidities. The severity and complexity of all assessed injuries often required multiple surgical procedures and extended hospital stays, with an admission length of ~10 days, with some patients requiring intensive care (17.37% of cases). Morbidity included complications like wound infections and long-term disabilities such as paralysis and traumatic brain injuries.

Conclusion

Despite legislative measures aimed at reducing such incidents, this study reveals an upward trend in gunshot injuries among children in Cape Town. Gunshot injuries remain a significant and increasing public health challenge among paediatric populations in Cape Town, with profound implications for morbidity, mortality, and healthcare resource utilization. Addressing this issue requires a comprehensive and multi-sectoral approach that prioritizes prevention, early intervention, and addressing the underlying social determinants of violence.

Highlights

Firearm Injuries in South Africa: Despite the 2004 Firearms Control Act, gun-related injuries and deaths in children increased from January 2011 – December 2020.

Demographics of Gunshot Injuries: Peak gunshot injury age: 5-9 years; boys 10-12 more affected. Injuries often from gang crossfire or drive-by shootings.

Complications and Long-Term Effects: High long-term morbidities (13.6%), including paralysis and nerve injuries, with increasing ICU admissions over 10 years.

Multifaceted Interventions Needed: Reducing gun violence requires legislative measures, community programs, and healthcare initiatives for greater impact.

Introduction

South Africa is not unfamiliar with violent crime, with at least 70,000 annual cases of murder and attempted murder. Of these, nearly 30 percent involved the use of firearms in 2019.(1) Between 1996 and 1999 Groote Schuur Hospital (GSH) in Cape Town was treating approximately 120 gunshot wound (GSW) patients per month.(2)

These crimes are of particular concern where they involve children. In the United States, trauma is the leading cause of morbidity and mortality in paediatric and adolescent populations, with 46,039 sustaining gunshot injuries over a 6-year review of a national trauma databank.(3) Firearm injuries were in the top five causes of fatal injury in children aged 0-14 in 3 out of 6 South African cities from 2001 to 2003, and in the top 3 in Cape Town during the same period.(4) Another Level One Hospital in Cape Town reviewed 1706 musculoskeletal gunshot injuries between 2014 and 2017, of which five percent were sustained by children.(5) In 2011 Naidoo and Van As remarked on the need for further research on the epidemiology of gunshot injuries affecting younger children in South Africa.(6)

Previous reviews have shown a decrease in children aged 0-12 years old experiencing firearm injury following the implementation of the 2004 Firearms Control Act.(7) However, South African Medical Research Council data has shown an increase in firearm-related deaths between 2011 and 2016 both nationally and in Cape Town.(8) This together with a general increase in violent crimes occurring over the last five years, we are interested to assess if gun violence against children may also be on the rise again.(1) Younger children are more likely to be unintentionally injured but have a higher mortality rate from these injuries.(3,9) Children under the age of 10 have also been shown to be more likely to have an adverse outcome following musculoskeletal firearm injuries than older children. In terms of injury patterns, approximately 50 percent result in injuries to extremities, half of which result in fractures. Head, neck, and chest injuries were more likely to result in mortalities. (7,9)

Around half of musculoskeletal firearm injuries need to be managed surgically, and the most frequent complications include vascular and nerve injuries as well as compartment syndrome, and fracture-related infections.(10)(11)(12) Non-unions also occur, and there is an association between these and fracture-related infections.(11) Fractures resulting from gunshot injuries also frequently require additional surgical procedures in the management of their complications.(13) These can include growth arrest secondary to injury to the physis and require multiple later-stage procedures to address resultant deformities.(14) Extremity injuries involving the musculoskeletal and neurovascular systems due to firearm injuries can also pose unique problems and complexity requiring creative approaches to limb salvage in some cases.(12)(15) The costs of orthopaedic injuries due to gunshot wounds across three local studies ranged from approximately R24000 to R37000 per patient at Cape Town public

hospitals, showing that aside from morbidity and mortality, these injuries carry a further high financial and resource cost to society.(5)(16)(17)

Our study aims to review the injury epidemiology of gunshot injuries in children over the preceding 10-year period (January 2011- December 2020), to assess trends in incidence and injury patterns. We also want to further analyse the extent of orthopaedic gunshot injuries in this group, in terms of types of injuries and their management. Red Cross War Memorial Children's Hospital (RXH) was chosen, given that previous reviews in the area have found minimal cases at private hospitals, and that nearly 80 percent of victims are seen at public sector tertiary hospitals. (7,18)

The study was approved by the University of Cape Town Human Research Ethics Committee. HREC no 331/2023 and institutional consent was obtained to access patient records from RXH.

Materials And Methods

This is a descriptive cross-sectional analysis of data over a 10-year period from January 2011-December 2020. Data bases included RXH data via ChildSafe which includes records of all trauma cases seen at Red Cross Hospital

All children aged 0-13 who presented to RXH with Firearm injuries between January 2011 and December 2020 were included. Those whose files were missing or incomplete were included if relevant data was available from alternative sources including the ChildSafe database, electronic records system or Picture Archiving and Communication System (PACS). Excluded cases were those that were found not to have firearm injuries on closer inspection of the patient record and who did not meet the inclusion age and date criteria. Most of the demographic data and some admission information could be captured in this way, however details of management or complications were often missing in these cases.

The following data were collected from the patient files as required and captured in an Excel spreadsheet for analysis: See Appendix 3 for sample spreadsheet.

Patients' folder numbers, gender, date of birth, age at presentation, postal code of home address, location where injury occurred, date of presentation and discharge, total stay in hospital, admission details, type of firearm, number of shots and wounds, circumstances of injury, Injury sites, number and type of surgical interventions, complications, morbidity, and survival or death. This was standardised by use of a google form to capture details from the files See Appendix 2. Additional columns for categories that could be calculated, for example, "Length of Stay" were calculated in Microsoft excel from the times and dates captured.

The data are described via descriptive and categorical analysis via means, ranges, and percentages.

Results

Demographics

The ChildSafe database provided 250 folder numbers. Of these 14 were completely excluded due to not having gunshot injuries, or insufficient demographic data. Of the remaining 236 cases, 29 files were missing and 207 had complete records. For the 29 files that were missing; data was captured utilising alternative sources including the ChildSafe system, electronic admission records and Picture Archiving and Communication System (PACS) system. A copy of the ChildSafe data capture sheet which is utilised for all presentations to the trauma unit is attached as Appendix 4. This included demographic data, some injury information, and admission and discharge dates. The remaining 207 full records included further detailed data points are used to facilitate a detailed discussion of varying complications of GSW in children.

From January 2011 to December 2020 236 cases matched the study criteria. This represented 0.33% of the total trauma cases (72189) managed at Red Cross War Memorial Children's Hospital (RXH) over the 10-year period.

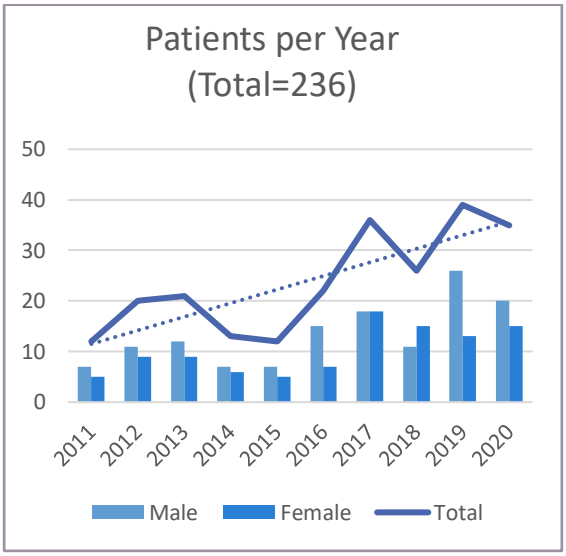


Figure 1: Patients seen in trauma unit with GSW each year from 2011-2020, with gender breakdown and trend

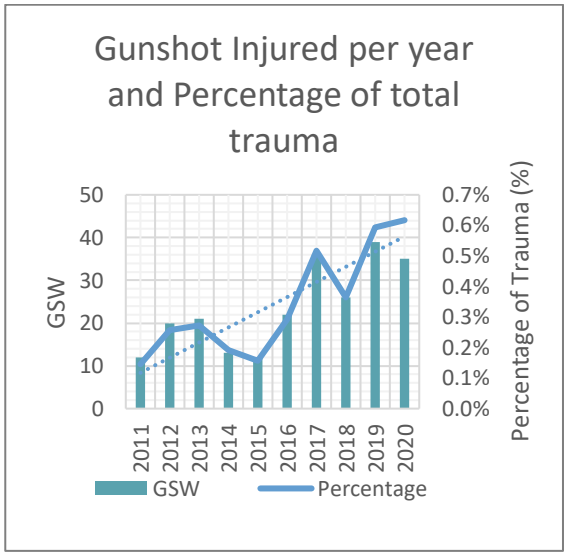


Figure 2: Patients seen in trauma unit with GSW each year from 2011-2020, Line representing gunshot injured patients as percentage of trauma unit visits

Of the 236 patients, 134 (56.8%) were male and the mean age was 7.7 years old. The 5-9 years old age bracket represented the largest sample (44%) of cases (n=105 patients). Those aged 10-12 made up

30% (n=71). Figure 3. In terms of gender, the distribution of males to females under the age of 10 was relatively equal. In the 10–12-year-old group, the proportion changed to 69%M:31%F.

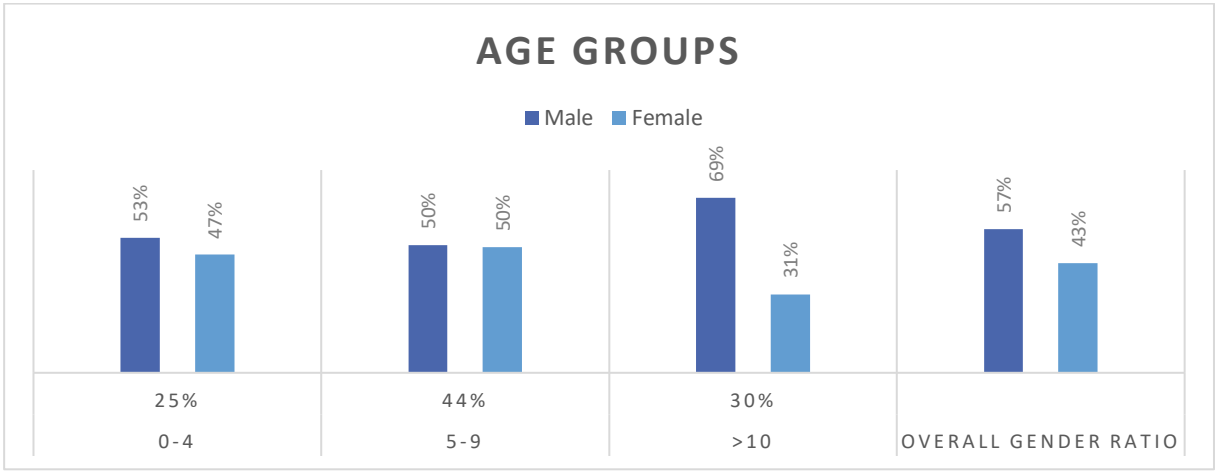


Figure 3: Patients grouped according to age groups with gender breakdown.

More than half (148) of the patients resided in five suburbs of Cape Town, with 47 and 41 coming from Athlone and Mitchells Plain respectively. The other three were Gugulethu, Lansdowne and Retreat with 22,20, and 18 cases respectively. There were increasing trends over time in injuries in the following areas: Retreat, Mitchells Plain, Gugulethu, Khayelitsha and Eerste River among others. Figure 4,Figure 5,Figure 6.

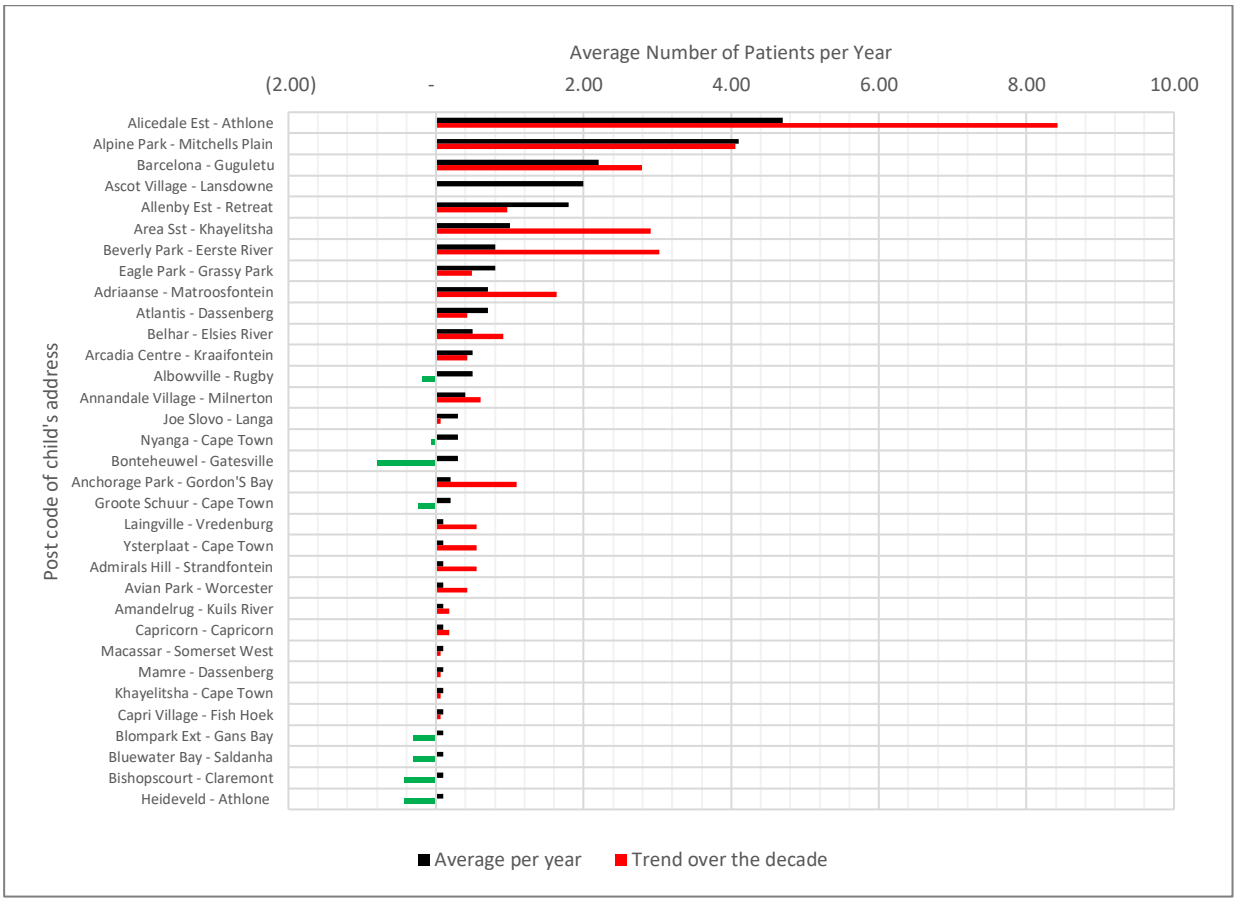


Figure 4: Average yearly number of patients presenting from each area of patient's residence, with trend in area over the decade

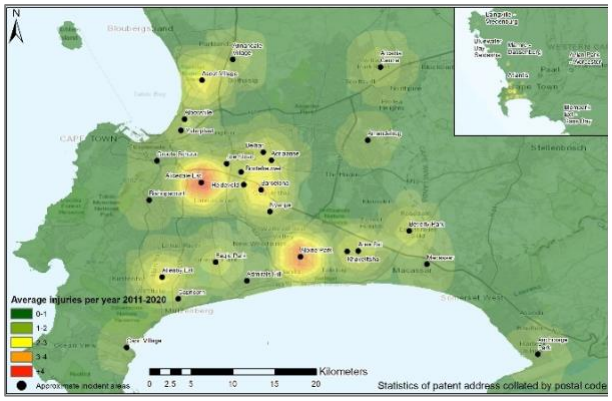


Figure 5: Map of average density of GSW at patients' postal code: using data of figure 4. Average incidence at postal code over the 10 years used to determine density at these addresses.

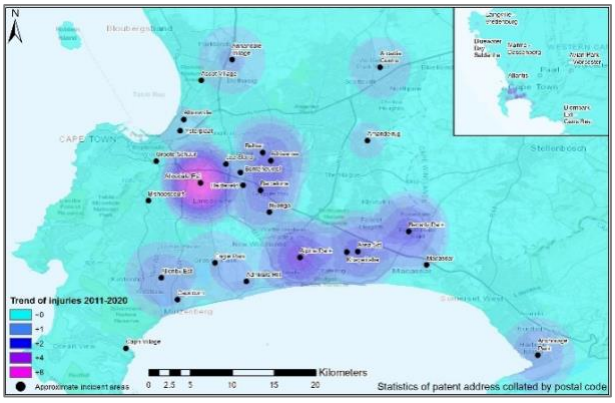


Figure 6: Map of average trend of density of GSW at patients' postal code over the decade 2011-2020: using data from figure 4. Map showing increasing or decreasing trend over the 10 years by colour coding according to magnitude of increase.

Circumstances

Gunshot Injuries as a ratio of total trauma cases showed an increasing trend but remained less than one percent of total trauma cases over the 10 years (Average 0.33%). Figure 2. The majority of cases (n=180 or 76.3%) sustained a single gunshot wound, while 22 (9.32%) sustained 2 gunshots, and 17 patients (7.2%) were shot 3 or more times, with one of those sustaining 10 gunshots. Figure 7. There was a statistically significant positive trend of + 2.69 GSW patients per year from 2011 to 2020 (p=0.0053, 95% CI 1.05 to 4.33).Figure 1 The type of firearm was not specified in 195(82.6%) cases. Of those known, 21 cases involved pellet or toy guns (8.9%), 15 cases (6.4%) specified handguns and in five cases (2.1%) the shots were with rubber bullets. Figure **8**

In 159 (67.4%) instances the injury occurred at or near the child's home or another private residence. Fifty-one (21.6%) occurred in public places, and 43(18.2%) occurred in the street. The location was not specified in 11 (4.7%) of cases. Figure **9**

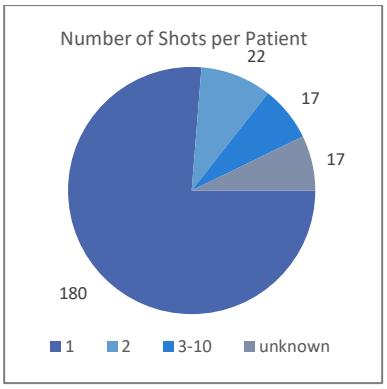


Figure 7: Number of shots sustained per patient (n)

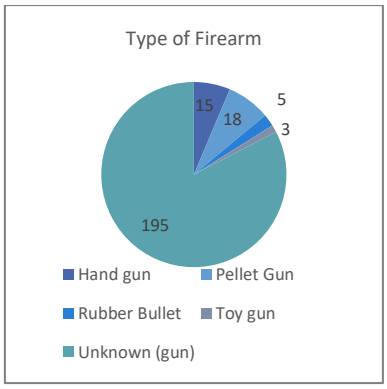


Figure 8: Patients according to type of firearm. Majority not captured in notes but injured with civilian firearm

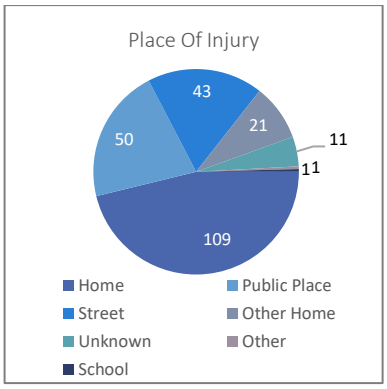


Figure 9: Place where Injury occurred.

The majority of wounds, 133(56.36%) occurred as a result of crossfire, while 27 (11.44%) were reported as accidental, 17 (7.2%) were noted as intentional, and 9 case (3.1%) were as a result of robberies and home invasions, while 50(21.19%) occurred as a result of unknown circumstances. In nine cases gang violence was specifically cited, with other's being the intended target in seven cases and multiple people injured in nine instances that were recorded in the clinical records. Figure 10

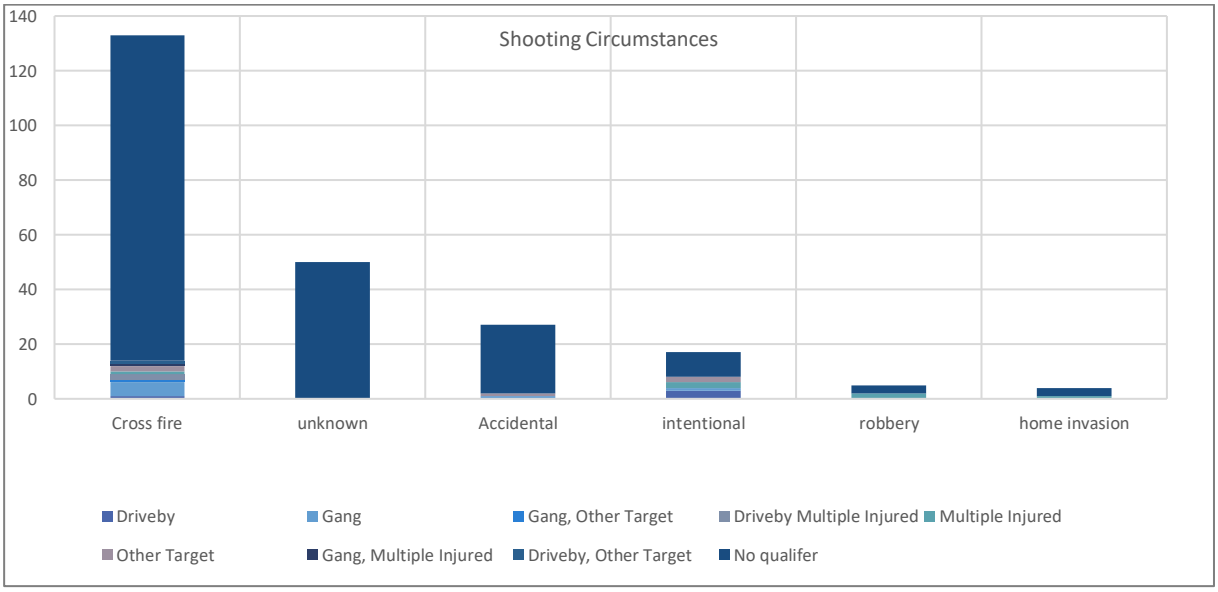
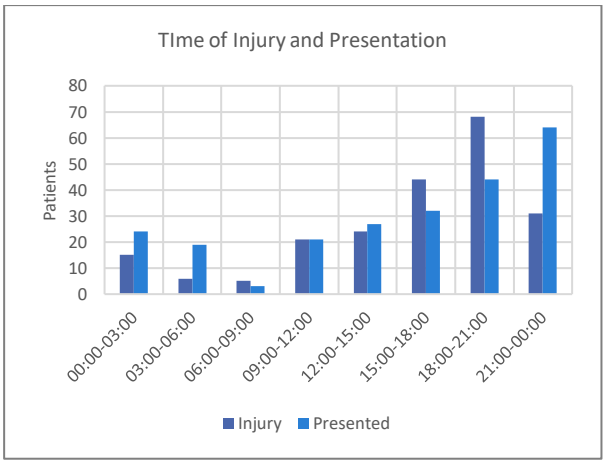


Figure 10: Circumstances of shooting. Main categories, with additional modifiers

Time of injury was recorded or calculated in 214 (91%) of cases and Time of presentation was captured in 234(99%) of cases. The majority of injuries (n=158, 73.8%) and presentations (n=164, 70.1%) occurred between 15h00 and 00h00. Figure 11. The time from injury to presentation varied substantially between the incidents, however, 100(45.9%) presented within 2 hours of injury, and 17(7.8%) presented after 24 hours. Figure 12.



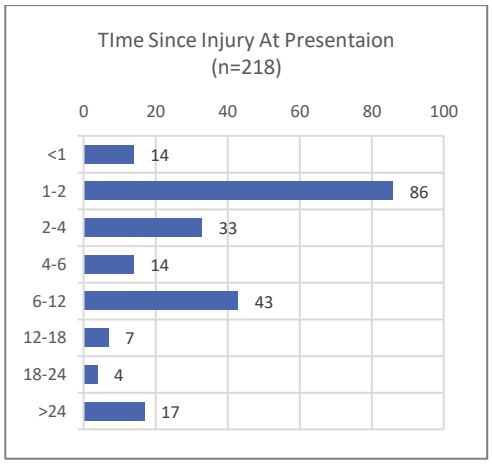
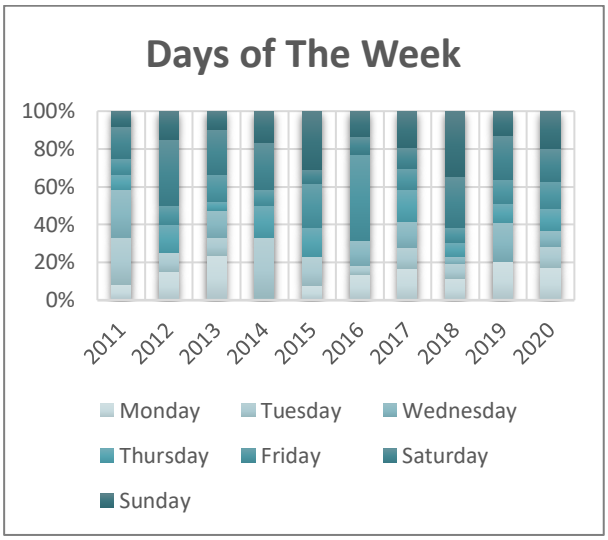


Figure 11: Times of injury and presentation over 24-hour period

Figure 12: Time since injury to presentation at RXH

The majority, 161(68.2%) are noted to have occurred around the weekend from Friday to Monday. The busiest single day of the week was Saturday with 46(19.5%) cases. Only 75(31.8%) of the cases presented on Tuesday through Thursday. Figure 13. There was a quarter-on-quarter increase with 43(18.22%) occurring from January to March and 73(30.93%) from October to December, with November showing the most frequent injury occurrence with 35(14.83%) cases. Figure 14



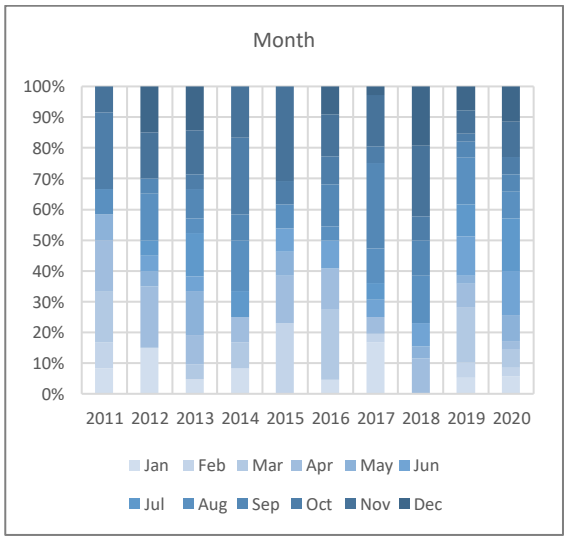


Figure 13: Days of the week presented as percentage of presentations

Figure 14: Months of the year presented as percentage of presentations

The gunshots injured 306 body areas, including 323 structures, of which 82 were isolated to the soft tissues. The majority of patients were injured in a single region, 185 (78.4%). Thirty-seven (15.7%) were injured in two body regions and 14 (5.9%) were injured in three to five regions. Figure 15

The majority of injuries occurred in the lower extremities (n=100) followed by head/face (n=64) and abdomen/pelvis/buttocks (62). The remainder of the injuries were to the upper extremities, chest and

back as noted in Table 1. The most frequent injuries were extremity fractures (54) followed by (42) Intra-abdominal injuries including 25 hollow viscus, and 17 solid organ injuries – occasionally co-occurring. There were 27 injuries to the face, excluding the eyes (n=16) and 23 brain injuries. The remaining injuries included lung, peripheral nerve, spinal cord and vascular injuries amongst others.

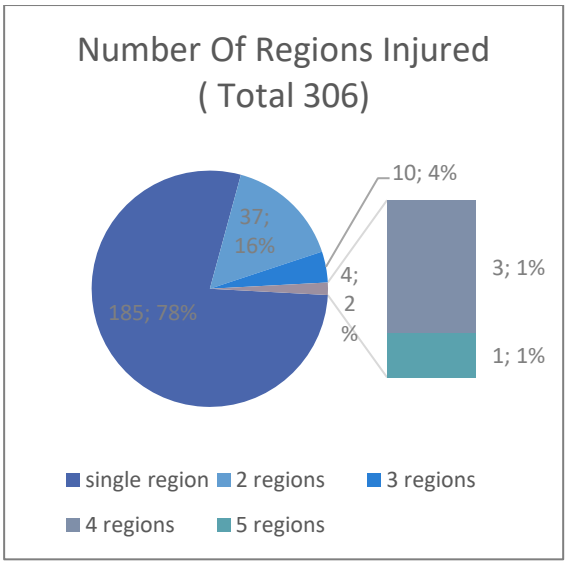


Figure 15: Children with number of body regions injured. Total body regions shot = 306

Outcomes

Of the 236 patients, 199 were admitted representing 84.32%. The median length of stay was 4 days while the average length of stay was extended to ~10 days as a result of several prolonged admissions, the longest of which was 117 days. The 236 patients accounted for 1989 inpatient days, of which 288 were ICU days during their initial admissions. Forty-one patients were admitted to the ICU which accounts for 17.37% of patients and 20.6% of the admissions. The average length of ICU stay was 7.6 days, with a median of 4 days. The longest ICU admission was 31 days. There was a greater tendency to admit patients later in the observational record with only 50% admitted in 2011 compared to 91.43% admitted in 2020. There was also a greater number of ICU admissions over time with 34.29% in 2020. Figure 16

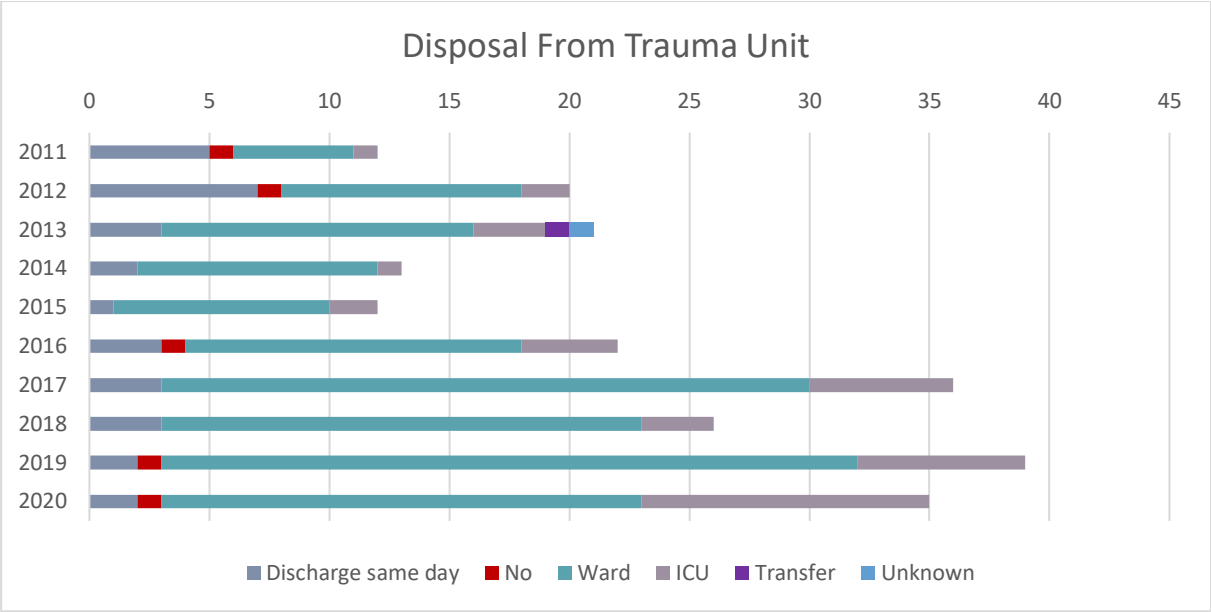


Figure 16: Patient disposal from trauma unit by year and location (NO= not admitted or discharged -died)

Procedures done in the trauma unit that did not require a formal trip to theatre included 13 bullet removals, 7 wound debridements, and 10 intercostal drains. During the initial admission, 87 patients underwent 114 operations with 8 patients undergoing multiple procedures in the first theatre episode. 16 Patients underwent further surgery during subsequent admissions. Most of the surgeries were done by general surgery (46) with laparotomies being the most frequent operation (25 + 7 relooks). There were 16 orthopaedic surgeries on initial admission and 14 neurosurgical procedures. Subsequent admission surgeries included 6 neurosurgical, 4 Orthopaedic and 5 General surgical procedures among others. Table 3. The available records of 17 patients did not indicate if surgery was or was not undertaken (these were among patients for whom the folders were missing and only basic admission information was available).

Thirty-five patients sustained complications. Of those, 27 sustained a single complication but 8 had two or more with one patient having five complications. The most frequent complication was wound complications (10) followed by hospital-acquired pneumonia (9) and surgical site infection (6). A further 28 cases had incomplete records, so it is not known if they had complications. Table 4.

There were 28 patients with morbidities – 10 of the patients had more than one morbidity. Ten were paralysed, 8 had sequalae of traumatic brain injury (TBI), and three lost vision in their eyes with miscellaneous other morbidities. A further 24 case records did not have information regarding morbidities and remain unknown. Table 5.

A total of 11 patients died with five of the deaths occurring recently in 2020 (only one of which was tested for Covid19 with a negative result returned). Of all the mortalities five occurred in the trauma unit and the other six died following admission to ICU. Eight cases had sustained isolated head injuries,

and one had an isolated chest injury. One patient was injured in the head and chest and one patient was injured to the head, back and both upper legs.

Table 1: Body regions injured by GSW

Region Injured	**No (%)**
Lower Extremity	*100(32.7%)*
Head/Face	*64(20.9%)*
Abdomen/Pelvis/Buttock/Groin	*62(20.3%)*
Upper Extremity	*32(10.5%)*
Chest	*29(9.5%)*
Neck/Back	*19(6.2%)*
Total	***306(100%)***

Table 2: Structures injured by GSW

Structure Injured	***Number (%)***
Isolated Soft Tissue	*82(25.4%)*
Fracture Extremity	*54(16.7%)*
Face	*27(8.4%)*
Hollow Viscus	*25(7.7%)*
Brain	*23(7.1%)*
Lung (Haemo/pneumothorax)	*22(6.8%)*
Solid Organ	*17(5.3%)*
Fracture Axial	*17(5.3%)*
Eye	*16(5.0%)*
Peripheral Nerve	*12(3.7%)*
Vascular	*12(3.7%)*
Spinal Cord	*8(2.5%)*
Rib #	*5(1.5%)*
Perineum	*2(0.6%)*
Heart	*1(0.3%)*
Total	***323(100%)***

Table 3: Surgical procedures performed on initial and subsequent admissions by category

Initial Admission	***Operations (n)***	***Subsequent Admission***	***Operations (n)***
General surgery (Abdominal)	*46*	*Neurosurgical*	*9*
Orthopaedic	*17*	*Orthopaedic*	*4*
Neurosurgical	*14*	*General surgery (Abdominal)*	*5*
Wound Management	*10*	*Bullet Removal*	*1*
Bullet Removal	*7*	*Maxillo-facial*	*2*
Maxillo-facial	*6*	*Wound Management*	*1*
Ophthalmology	*5*		
Vascular	*5*		
Miscellaneous	*4*		
Unknown	*5*		
Total Procedures	***119***	***Total Procedures***	***22***

Table 4: Complications sustained: Total of each type of complication

Complication	***Number (n)***
Wound Complications	*10*
Surgical Site Infection	*6*
Surgical complication - nerve	*1*
Sepsis	*4*
Recurrent Pneumothorax	*1*
Recurrent Meningitis	*1*
Musculoskeletal - knee flexion contracture	*1*
Musculoskeletal - leg length discrepancy (late)	*1*
Musculoskeletal - soft tissue contractures	*1*
Hospital Acquired Pneumonia	*9*
Decubitus Ulcers	*4*
DVT	*1*
Gastric Outlet Obstruction	*1*
CSF leak	*1*
Hypoxic Brain Injury	*1*
subglottic stenosis	*1*
UTI	*2*
epilepsy	*1*
Total	***47***

Table 5: Number of patients with listed major morbidities and additional morbidities

Morbidity	*Number (n)*	*Additional Morbidity*	*Number (n)*
Paralysis	*9*	*Neuropathic Bladder/Incontinence*	*4*
TBI sequelae	*7*	*Epilepsy*	*3*
Neurological	*4*	*Hypertension*	*2*
Loss of vision	*3*	*Hemiplegia*	*2*
Colostomy	*2*	*Paralysis*	*1*
Tracheostomy	*2*	*Amputation*	*1*
Deformity	*1*	*CRE*	*1*
Total	***28***	***Total***	***14***

Orthopaedic

Orthopaedic injuries occurred in 69 (29.2%) patients and consisted of 71 fractures (54 extremity and 8 pelvic and 9 spinal), 12 peripheral nerve injuries and 8 spinal cord injuries (associated with spinal fractures), totalling 91 (38.6%) orthopaedic injuries. The trend of increasing injuries is also noted in the increasing yearly number of fractures from 2011-2020. A breakdown of the fractures is shown in Table 6 The most frequently occurring fractures were to the femur (11), spine (9), and pelvis (8). The associations of the fractures with other injuries are also shown. There were 38 lower extremity (excluding pelvis) fractures from 100 lower extremity injuries and 16 upper extremity fractures from 32 upper extremity injuries. Table 7 describes more detail of the neurological injuries. On 8 occasions fractures were associated with peripheral nerve injuries. One of these also had an associated vascular injury requiring repair. Additionally, one fibula fracture was also associated with a vascular injury. Sixteen patients (18 fractures) with orthopaedic injuries had additional injuries involving other systems. More than one fracture occurred in five patients (six fractures were associated with additional fractures). Table 8 describes the number of patients with various injury combinations.

In terms of management, 45 fractures (51 patients) received non-operative management, of which 34 fractures were managed in plaster of Paris, four in traction and 24 with observation or rehabilitation. Patients who had both non-operative as well as surgical management amounted to 11 (14 fractures) in some cases they had multiple fractures and of which some were treated non-operatively and others surgically. There were 16 orthopaedic surgeries in 13 patients during the initial admission, including five debridements and POP, five arthrotomies, two of which included bullet removal, two external fixations, three femur nails and one tendon and nerve exploration. Additional surgeries at subsequent admissions included one deformity correction, and one bilateral above-knee amputation for a paraplegic patient (counted as two procedures). The four isolated pelvic fractures were treated non-operatively except for one requiring bullet removal from the SI joint and one with other associated injuries also required a hip arthrotomy. Fractures that were associated with surgery to other systems amounted to 19 in 17 patients during the initial admission, most commonly laparotomies for abdominal injuries. There were five orthopaedic patients requiring non-orthopaedic surgeries on subsequent admissions. Table 9 summarizes these interventions according to fracture type.

Of the patients with orthopaedic injuries, 9 had complications: two wound complications, two with decubitus ulcers, one leg length discrepancy, one knee flexion contracture and one patient requiring ICU for associated injuries developed hospital-acquired pneumonia. Morbidities occurred in 15 patients, including one patient with a deformity due to physeal growth arrest requiring subsequent corrective surgery, four of the patients with nerve injuries did not recover, including one brachial plexus injury. The 9 patients with spinal cord injury (SCI) continued to suffer morbidities associated

with their paralysis and bladder problems. Two of the patients required tracheostomies for their long stays in ICU for associated injuries. A single patient with a pelvic and femur fracture died due to an associated head injury.

Table 10 summarizes the outcome of various orthopaedic injury types in terms of their disposal, complications, morbidities, and deaths.

Table 6 : Orthopaedic injury types and associations

Injury	*n (%)*	*Associated Fractures (n)*	*Associated Peripheral nerve*	*Associated Vascular*	*Other system head/chest/ abdominal injury*
Fracture - Femur	*11(15.5%)*	*2*	*3*	*1*	*2*
Fracture - Spine	*9(12.7%)*		*1*		*7*
Fracture - Pelvis	*8(11.3%)*	*1*			*4*
Fracture - Fibula	*7(9.9%)*		*1*	*1*	
Fracture - Ankle	*5(7.0%)*		*1*		*1*
Fracture - Hand	*5(7.0%)*		*1*		
Fracture - Tibia	*5(7.0%)*				
Fracture - Clavicle	*4(5.6%)*	*1*			*3*
Fracture - Calcaneus	*3(4.2%)*	*1*			
Fracture - Radius	*3(4.2%)*		*1*		*1*
Fracture - Talus	*3(4.2%)*				
Fracture - Foot	*2(2.8%)*			*1*	
Fracture - Navicular	*2(2.8%)*				
Fracture - Humerus	*1(1.4%)*				
Fracture - Scapula	*1(1.4%)*	*1*			
Fracture - Ulna	*1(1.4%)*				
Fracture - Wrist	*1(1.4%)*				
	71(100%)	***6***	***8***	***3***	***18***
Spinal Cord	*8*	*6*			*8*
Peripheral Nerve	*12*	*8*			*1*
	20				
	91				

Table 7. Neurological injuries (excluding TBI/facial nerve), number and percentage of total orthopaedic injuries

Neurological		***(n)***	***Orthopaedic Patients (%)***
Spinal Cord	*Spinal Cord Injury*	*8*	*11.9%*
Peripheral	*Brachial Plexus*	*1*	
	Peripheral Nerve - Common Peroneal	*1*	
	Peripheral Nerve - L5	*1*	
	Peripheral Nerve - Superficial Peroneal	*1*	
	Peripheral Nerve - Ulnar	*1*	
	Peripheral Nerve	*4*	
	Peripheral Nerve - Anterior Interosseous	*1*	
	Peripheral Nerve - Sciatic	*2*	
	Total	***12***	***17.4%***

Table 8: Number of patients with various combinations of orthopaedic injuries

Injury Combination	*Patients*
Fracture Isolated	*45*
Fracture + Peripheral Nerve Injury	*7*
Fracture + Vascular Injury	*1*
Fracture + Peripheral Nerve + Vascular Injury	*1*
More than 1 Fracture	*5*
Isolated Peripheral Nerve Injury	*2*
Fracture + Other Systems	*16*

Table 9: Management of fractures seen. Non-operative and operative orthopaedic management. Occurrence of other system surgery. * Denotes procedures done at subsequent admissions.

	Non-Op Only	Traction	Plaster Cast	Observation/ rehab	Non-op + Ortho	Arthrotomy (+ bullet	Debridement and POP	ORIF - femur nail	External Fixation	Tendon and Nerve repair	Above knee amputation	Deformity correction **	Other system surgery
Fracture - Ankle	*4*		*3*		*1*	*1*	*1*						*1*
Fracture - Calcaneus	*2*		*2*	*1*	*1*								
Fracture - Clavicle	*2*			*4*									*1 (1*)*
Fracture - Femur	*2*	*4*	*5*		*6*	*1(1)*	*2*	*3*	*1*			*1**	*3*
Fracture - Fibula	*7*		*7*										
Fracture - Foot	*2*		*2*										
Fracture - Hand	*6*		*2*	*3*									*1*
Fracture - Humerus	*1*			*1*									
Fracture - Navicular	*1*		*1*										
Fracture - Pelvis	*2*			*5*	*2*	*1(1)*							*4 (1*)*
Fracture - Radius			*3*		*1*		*1*			*1*			*2*
Fracture - Scapula													*1*
Fracture - Spine	*8*			*9*	*1*						*2**		*7 (2*)*
Fracture - Talus	*2*		*2*	*1*	*1*	*1*							
Fracture - Tibia	*5*		*5*										
Fracture - Ulna			*1*		*1*		*1*		*1*				
Fracture - Wrist	*1*		*1*										
	45	***4***	***34***	***24***	***14***	***5***	***5***	***3***	***2***	***1***	***2****	***1****	***19 (5*)***

Table 10: Outcomes of orthopaedic injuries (NOT patient numbers) according to injury type.

		Disposal			Complications			Morbidity					
	No	Discharged	Ward	ICU	Ortho Complication	ICU Complication	Other system complication	Persistent Nerve Fallout	SCI - related	Non-Ortho Morbidity	Amputations	Morbidity Deformity	Death
Fracture - Ankle	5	1	3	1		1	1						
Fracture - Calcaneus	3		3										
Fracture - Clavicle	4		3	1			1			1			
Fracture - Femur	11		8	3	1			1				1	1
Fracture - Fibula	7		7										
Fracture - Foot	2		2										
Fracture - Hand	5		5										
Fracture - Humerus	1		1										
Fracture - Navicular	2		2										
Fracture - Pelvis	8		7	1			1						
Fracture - Radius	3		2	1									
Fracture - Scapula	1		4	4	2		1			1			
Fracture - Spine	9		2					1	7	2	2		
Fracture - Talus	3	1	4		1								
Fracture - Tibia	5	1											
Fracture - Ulna	1	1											
Fracture - Wrist	1												
	71	**4**	**53**	**11**	**4**	**1**	**4**	**2**	**7**	**4**	**2**	**1**	**1**
Spinal Cord	8								9				
Peripheral Nerve	12							4					

Discussion

Our series showed 236 cases over ten years with an increasing trend over time. The previous series by Cambell et al looking at the previous two decades had shown a decrease in children presenting to the Red Cross Children's Hospital with firearm injuries following the introduction of the Firearms Control Act of 2004.(7) They had assessed 163 cases over the decade 2001 to 2010 which showed a decrease from the earlier study by Hutt, Van As et Al.(9)

The peak age group in our population sustaining gunshot injuries was from 5-9 years old which differs from Hadley et al in KZN 1998 who found a peak age was between 3-4 years.(19) Additionally we saw that below the age of 9, injuries were relatively equally spread between male and female patients, whereas from 10-12, nearly two thirds were male. This may suggest that males over 10 are more likely to find themselves in violent circumstances. Similarly, a 10-year epidemiological study of open fractures in children in the UK also found a male predominance (74.6%). However, the median age in that study was higher at 11 years old. The incidence of open fractures was also higher in adolescents in their study.(20) While gangsterism wasn't directly specified in most cases, it was mentioned in 9 cases. Additionally, the majority of cases circumstances were related to crossfire and several others were parts of drive by shootings which may indicate a high level of gang-related activity in these areas.

The type of firearm wasn't specified in the majority of cases, which differs from Cambell's series.(7) However, only a small proportion of injuries were NOT civilian firearm injuries (Pellet and Toy guns 21/236). Also noteworthy was that five of the patients were injured by rubber bullets which are commonly used by police. This may be an indication of increasing exposure of children to violence in their neighbourhoods.

The exact location where the injury occurred was seldom captured. This may be in part due to the design of the trauma clerking sheet used by Child Safe which employs a tick sheet and while there is an additional space for capturing the location, it wasn't captured to a sufficient degree that it was helpful for this study. Nearly half of the cases occurred near the home address of the patients, with another 21.2% at other private homes. Using the home postal code to highlight neighbourhoods with the highest rates and to track trends over the 10 years, these data could potentially inform policymakers and law-enforcement capacity deployment strategies. Additionally, the timing of the injuries being clustered around the weekend and later evenings might also inform service providers' decisions concerning staffing emergency centres.

More than 50% of cases presented more than 2 hours following the injury, with 7.8% presenting more than 24 hours after the injury. This could be due to more patients first presenting to local district

hospitals and receiving initial management and stabilization before transfer to the tertiary centre, unfortunately, these data were not captured.

There was an upward trend in admissions and ICU admissions as a proportion of total annual cases over time. This could indicate increasing severity of injury or improved resource availability for managing these injuries.

The number of complications and morbidities over time increased with most of each occurring in the second five years. Nearly half (five of eleven) of the deaths occurred in 2020 despite a slight decrease in the number of cases from 2019 to 2020 (39 to 35).

Table 11 and Figure 17 summarize the number of complications, morbidities and deaths year on year. All of them had head injuries. Four were admitted to ICU and one died in the trauma unit. Only one of them was tested for COVID-19 and was negative, so it is unclear if the pandemic had any direct influence on the outcome. Indirectly though, it is noted that in the United States, a 30% increase in gun violence was reported during the pandemic from 2020-2021.(21) A local study on the effects of the hard lockdown in South Africa from April to May 2020 on presentation to a tertiary trauma centre with the same drainage area found a temporary marginal decrease (15%) in patients presenting with GSW, followed by a rebound 80% increase from pre-lockdown numbers.(22)

The findings of this study that 21.6% sustained more than one injury echo the findings in a 12-year series from KZN that multisystem injury in children injured by firearms is common.(19)

In terms of comparing regions injured to the 10-year series at the same site by Cambell et el., Our series had 132 extremity injuries making up 43.2% of the gunshot injuries, whereas Cambell had only 100 cases, but they made up 55.8% of the gunshot injuries. Cambell et al showed 26 head injuries (14.5%) whereas our numbers were much higher with 61 cases (20%). Our series had a higher number of deaths in hospital (11) vs three in Cambell's series. This may indicate improved pre-hospital care but also highlights the increasing number of head injuries which were the main cause of mortality.(7)

Forty-three percent of injuries were to the extremities with 41% of Extremity injuries resulting in fractures. Half of upper extremity injuries resulted in fractures compared to 38% in the lower extremity. Almost all of the spinal fractures were associated with spinal cord injury (8/9). Other studies of gunshot-associated fractures in children have shown a predominance of lower extremity fractures (22% Tibia and 30% femur) Whereas in our series the lower limb fractures only reach nearly 50% when including foot and ankle fractures (Femur 15%, Tib/fib 17%, Ankle/foot 21%). Our study had a higher proportion of spinal (n=9,13%) and pelvic (n=8, 11%) fractures. Several studies of fractures associated with gunshot injuries show a higher number of lower vs upper extremity fractures. (11,12,16,23–25)

A fairly low number of the orthopaedic injuries required operative management. These were 16 orthopaedic procedures of which only two were external fixations and three were Closed reduction and internal fixation (CRIF - femur nails). The majority of the other cases were wound debridements or arthrotomies ± bullet removal ± Plaster of Paris (8/17) with only one soft tissue procedure for tendon/nerve exploration and repair. This differs significantly from a US study which had 50% washout/debridement (vs our 65%), 33% internal fixation (vs our 18%) and 8% external fixation(ex-fix) (vs our 12%). However, that study included adolescents which may account for the higher rate of fixation of fractures. They proposed a treatment algorithm based on the velocity of the mechanism and stability of the fracture patterns. This algorithm therefore highlights the need to as-accurately as-possible indicate the type of firearm utilised in the incident. Our Operative rate was also less than another international study of children and adolescents who operated on 29% of their patients vs our 23%. Most of their surgeries were also debridements, with 12% of ex-fixes mirroring ours. (13) Unlike other studies focussing exclusively on orthopaedic gunshot injuries, ours did not capture if routine antibiotics were given. However other than one patient with a pelvic fracture with an abdominal injury requiring laparotomy; there were none with wound or septic complications. There were no non-unions. Whereas in the literature the non-union and FRI rates range from 3.1-9% and 3.2-11% respectively. (5,11,13)

Long-term morbidities were seen in the form of paralysis and associated complications in all of the spinal cord injury patients, with one patient with physeal growth arrest requiring later corrective surgery for a deformity, and long-term fallout in those with nerve injuries. This made up 16.5% of the patients with orthopaedic injuries. A fairly high proportion, but very much skewed by the high number of spinal injuries. Similarly, a local study of the burden of orthopaedic injuries in a population 13 years and older, showed major morbidity of paraplegia, hemiplegia and peripheral nerve deficits was 11.4% of survivors.(16)

Aside from physical injuries to the child, firearm injuries also lead to considerable societal burdens, encompassing financial expenses and the loss of human lives and productivity. The emotional distress to the child and family is also difficult to quantify.(25)

Various Studies provide recommendations for reducing gun violence. Overall, a multifaceted approach that integrates legislative measures, community-based interventions, public education, and healthcare initiatives is necessary. Both Naidoo and Van As (2011) in Cape Town, and Hadley and Mars from KZN (1998) argue for the necessity of strict firearm legislation to disarm communities.(6,19) Our study has shown that despite stricter legislation, there is an upward trend in gun violence affecting younger children. To this end, additional interventions to address the root causes of violence in these communities are needed. Hadley and Mars also recommended community programs focussing on

conflict resolution, economic development and social cohesion. Internationally Arslan et al (2002) recommended focusing on public education about the dangers of gun ownership and emphasizing safe and responsible storage and usage of firearms(12). Finally, healthcare workers can play an important role in advocating for stricter laws and participating in community education initiatives, as well as enhancing the medical care of gunshot victims.(9)

Table 11: Annual Number of Patients with GSW, Complications, Morbidities and Death. Shading to indicate higher frequency

Year	Total pts	Complications	Morbidities	Deaths
2011	12	1	1	1
2012	20	2	1	1
2013	21	3	2	0
2014	13	2	3	0
2015	12	2	0	1
2016	22	5	2	1
2017	36	4	5	0
2018	26	4	4	0
2019	39	6	5	2
2020	35	6	6	5
Total	236	35	29	11

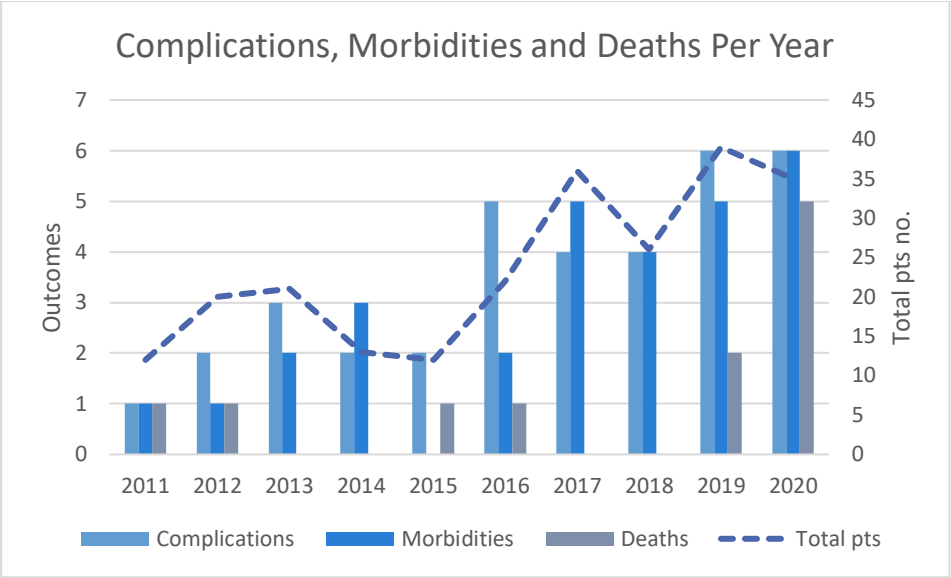


Figure 17: Year on Year complications, morbidities and deaths with trend of total injured patients.

Conclusion

Despite legislative measures aimed at reducing such incidents, this study reveals an upward trend in gunshot injuries among children in Cape Town. The rates of admission, complications, morbidity and mortality all increased particularly over the second half of the decade studied. Extremity and orthopaedic injuries made up the majority of the injuries but had relatively low rates of complications or requiring surgery, but a high rate of morbidity in those with spinal cord injuries.

Gunshot injuries remain a significant and increasing public health challenge among paediatric populations in Cape Town, with profound implications for morbidity, mortality, and healthcare resource utilization. Addressing this issue requires a comprehensive and multi-sectoral approach that prioritizes prevention, early intervention, and addressing the underlying social determinants of violence.

Limitations of this study include its retrospective nature and that it was conducted over a single centre. There was a fairly large proportion of patients (29) for whom the files were not available and data needed to be captured using alternative sources. In these cases there were at times no or limited data relating to surgeries, complications or morbidities which may make it difficult to generalize and compare to other studies. Their demographic and admission data was useful though, and five of the 11 deaths were identified among these patients. Additional difficulties related to the retrospective nature were findings that some information was not always captured in detail such as place of injury or specific type of weapon. The increased capacity of local district hospitals to manage these patients may have resulted in fewer patients presenting to the tertiary centre, particularly with more minor

injuries. This may mean that our results underrepresent the severity of the problem. The numbers in the study also do not include those who may have died before reaching the hospital. Potential future research in this domain should include a wider range of facilities. In the past this may have been limited with difficulty identifying patients from trauma registers, however recent implementation of electronic information systems could aid in identifying patients more easily. As gunshot injuries are a pervasive issue in our society, it would also be advantageous to have a standard data capture tool for all patients presenting with gunshot injuries to any of our state facilities. Information such as type of firearm, address of injury, circumstances, if attacker was known to victim or their family. This could be saved in a database and aid social worker and police investigations as well. This could aid future studies. The study could also be repeated for the adolescent population aged 13-17 years old, with factors differing from the younger child population examined. Another interesting factor that could be examined in future studies would be an assessment of social deprivation, similar to the index of multiple deprivation used in the UK. This was studied in relation to open fractures in children in the UK in a study in which there were no GSW, however there was no clear correlation found in that study.(20)

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Appendices

Appendix 1: Instructions to Authors – Injury

Introduction

Submission checklist

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

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Sex generally refers to a set of biological attributes that are associated with physical and physiological features (e.g., chromosomal genotype, hormonal levels, internal and external anatomy). A binary sex categorization (male/female) is usually designated at birth (""sex assigned at birth""), most often based solely on the visible external anatomy of a newborn. Gender generally refers to socially constructed roles, behaviors, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time. Gender influences how people view themselves and each other, how they behave and interact and how power is distributed in society. Sex and gender are often incorrectly portrayed as binary (female/male or woman/man) and unchanging whereas these constructs actually exist along a spectrum and include additional sex categorizations and gender identities such as people who are intersex/have differences of sex development (DSD) or identify as

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Acknowledgements

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Examples of References

Journal Articles

1. Standard Journal Articles (List all authors when six or less; when seven or more, list the first six and add et al. Do not repeat page numbers).

Frame JD, Frame JE. Modifying integra as a regeneration template in deep tissue planes. *J Plast Reconstruct Aesthet Surg* 2006;59: 460-4.

Books

1. Book chapter
Lister GD. Skin flaps. In Green DP, editor. *Operative Hand Surgery*. 3rd ed. New York: Churchill Livingstone; 1993, p. 1741-1823.

2. Book
Book: Mathes SJ, Nahai F. *Reconstructive Surgery: principles, anatomy, and technique*. New York: Churchill Livingstone; 1997.

Website

Uebersax J. A practical guide to local dependence in latent class models. http://ourworld.compuserve.com/homepages/jsuebersax/condep.htm.

Dataset

[dataset] Oguro M, Imahiro S, Saito S, Nakashizuka T. Mortality data for Japanese oak wilt disease and surrounding forest compositions, Mendeley Data, v1;
2015. http://dx.doi.org/10.17632/xwj98nb39r.1.

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Examples:

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[1] J. van der Geer, J.A.J. Hanraads, R.A. Lupton, The art of writing a scientific article, J. Sci. Commun. 163 (2010) 51–59. https://doi.org/10.1016/j.Sc.2010.00372.

Reference to a journal publication with an article number:

[2] J. van der Geer, J.A.J. Hanraads, R.A. Lupton, 2018. The art of writing a scientific article. Heliyon. 19, e00205. https://doi.org/10.1016/j.heliyon.2018.e00205.

Reference to a book:

[3] W. Strunk Jr., E.B. White, The Elements of Style, fourth ed., Longman, New York, 2000.

Reference to a chapter in an edited book:

[4] G.R. Mettam, L.B. Adams, How to prepare an electronic version of your article, in: B.S. Jones, R.Z. Smith (Eds.), Introduction to the Electronic Age, E-Publishing Inc., New York, 2009, pp. 281–304.

Reference to a website:

[5] Cancer Research UK, Cancer statistics reports for the UK. http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/, 2003 (accessed 13 March 2003).

Reference to a dataset:

[dataset] [6] M. Oguro, S. Imahiro, S. Saito, T. Nakashizuka, Mortality data for Japanese oak wilt disease and surrounding forest compositions, Mendeley Data, v1, 2015. https://doi.org/10.17632/xwj98nb39r.1.

Reference to software:

[7] E. Coon, M. Berndt, A. Jan, D. Svyatsky, A. Atchley, E. Kikinzon, D. Harp, G. Manzini, E. Shelef, K. Lipnikov, R. Garimella, C. Xu, D. Moulton, S. Karra, S. Painter, E. Jafarov, S. Molins, Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88), Zenodo, March 25, 2020. https://doi.org/10.5281/zenodo.3727209.

Supplementary material

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In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

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After acceptance

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Contact details for questions arising after acceptance of an article, especially those relating to proofs, will be provided by the publisher.

Appendix 2: Data Capture Form

Paeds GSW data

Data Collection

1. Hospital

   Mark only one oval.

   - ◯ RXH
   - ◯ GSH

2. Folder No

   _____

3. Surname

   _____

4. Name

   _____

5. Date or Birth

   _____

   Example: 7 January 2019

6. Gender

Mark only one oval.

- ◯ Male
- ◯ Female

7. Street

_____

8. Suburb

_____

9. postal code

_____

Presentation

If Data not available type xxx

10. Date of Presentation

_____

Example: 7 January 2019

11. Date of Injury

_____

Example: 7 January 2019

12. Time Presented

Example: 8.30 a.m.

13. Time of Injury

Example: 8.30 a.m.

14. Injury Location

Mark only one oval.

- Home
- Other Home
- Street
- School
- Public Place
- Sport
- Other
- Unknown

15. Injury Address if known

16. Type of Firearm

Mark only one oval.

- ◯ Hand gun
- ◯ Pellet Gun
- ◯ Rifle
- ◯ Shotgun
- ◯ Unknown
- ◯ Other: _____

17. Number of Shots

_____

18. Number of Wounds

_____

19. Circumstances

Mark only one oval.

- ◯ Intentional
- ◯ Accidental
- ◯ Cross fire
- ◯ Self Harm
- ◯ unknown
- ◯ Other: _____

20. Site of Injury

Tick all that apply.

- [ ] head
- [ ] Neck
- [ ] Chest
- [ ] Abdomen
- [ ] Pelvis
- [ ] Back
- [ ] Upper Arm
- [ ] Lower Arm
- [ ] Hand
- [ ] Buttock
- [ ] Upper Leg
- [ ] Lower Leg
- [ ] Foot
- [ ] Shoulder
- [ ] Elbow
- [ ] wrist
- [ ] groin
- [ ] Hip
- [ ] Knee
- [ ] Ankle

21. Structure Injured

Tick all that apply.

- [ ] Skull
- [ ] Brain
- [ ] face
- [ ] eye
- [ ] Spinal Cord
- [ ] Peripheral Nerve
- [ ] Lung
- [ ] Heart
- [ ] Vascular
- [ ] Visceral
- [ ] Solid Organ
- [ ] Fracture
- [ ] Soft Tissue
- [ ] Other: _____

Management

22. Admission

Tick all that apply.

- [ ] Trauma Ward
- [ ] ICU
- [ ] Orthopaedic Ward
- [ ] Discharge same day
- [ ] Surgical ward
- [ ] Other: _____

23. Non-Surgical Management

Tick all that apply.

- [ ] Observation
- [ ] Supportive
- [ ] Plaster Cast
- [ ] Traction
- [ ] intubation
- [ ] transfusion
- [ ] Other: _____

24. Surgery

Mark only one oval.

- ◯ Yes *Skip to question 25*
- ◯ No *Skip to question 28*

Operations

25. Theatre episode 1

Tick all that apply.

- [ ] initial admission
- [ ] subsequent admission
- [ ] ICP Monitors
- [ ] Craniotomy
- [ ] Neuro Other
- [ ] Thoracotomy
- [ ] Laparotomy
- [ ] Laparoscopy
- [ ] Vascular
- [ ] General Other
- [ ] External Fixator
- [ ] ORIF
- [ ] Arthrotomy
- [ ] Debridement +- POP
- [ ] Ortho Other
- [ ] Plastics
- [ ] Other: _____

26. Theatre episode 2

Tick all that apply.

- [ ] initial admission
- [ ] subsequent admission
- [ ] ICP Monitors
- [ ] Craniotomy
- [ ] Neuro Other
- [ ] Thoracotomy
- [ ] Laparotomy
- [ ] Vascular
- [ ] General Other
- [ ] External Fixator
- [ ] ORIF
- [ ] Arthrotomy
- [ ] Debridement +- POP
- [ ] Ortho Other
- [ ] Plastics
- [ ] Other: _____

27. Theatre episode 3

Tick all that apply.

- [ ] initial admission
- [ ] subsequent admission
- [ ] ICP Monitors
- [ ] Craniotomy
- [ ] Neuro Other
- [ ] Thoracotomy
- [ ] Laparotomy
- [ ] Vascular
- [ ] General Other
- [ ] External Fixator
- [ ] ORIF
- [ ] Arthrotomy
- [ ] Debridement +- POP
- [ ] Ortho Other
- [ ] Plastics
- [ ] Other: _____

Outcome

28. Complications

Tick all that apply.

- [ ] SSI
- [ ] Wound infection
- [ ] DVT
- [ ] LRTI
- [ ] HAP
- [ ] None
- [ ] Other: _____

29. Morbidity

Tick all that apply.

- [ ] TBI sequela
- [ ] paralysis
- [ ] amputation
- [ ] other disabilty
- [ ] None
- [ ] Other: _____

30. Death

Mark only one oval.

- ◯ yes
- ◯ no

31. Date of Death

_____

Example: 7 January 2019

32. ICU admission date

_____

Example: 7 January 2019

33. ICU discharge Date

_____

Example: 7 January 2019

34. Date of Discharge

Example: 7 January 2019

Unique ID	Hospital	Date or Bir	Age at Injui	Gender	Area	postal cod	Date of Inju	Year	Month	Day	Time Prese	Hour of pre	Injury Loca	Age at Pres	Date of Pre	Year	Month	Day
119102473I	RXH	2007/01/01	4.4	Female	Langa	7455	2011/05/18	2011	5	18	09:10:00	9	Home	4.4	2011/05/18	2011	5	18
24877532R	RXH	2006/01/31	6.6	Female	Hanover Pa	7780	2012/09/15	2012	9	15	19:30:00	19	Home	6.6	2012/09/15	2012	9	15
40295834R	RXH	2004/04/11	9.1	Female	Atlantis	7349	2013/05/01	2013	5	1	20:20:00	20	Home	9.1	2013/05/01	2013	5	1
15426158R	RXH	2005/10/14	8.8	Male	Grassy Parl	7941	2014/08/01	2014	8	1	22:00:00	22	Public Place	8.8	2014/08/01	2014	8	1
148855893I	RXH	2010/08/09	4.5	Female	Eerste Rive	7100	2015/02/03	2015	2	3	21:45:00	21	Public Place	4.5	2015/02/03	2015	2	3
13512298R	RXH	2014/11/09	1.4	Male	Khayelitsha	7784	2016/03/31	2016	3	31	00:20:00	0	Home	1.4	2016/04/01	2016	4	1
157125709I	RXH	2009/10/01	6.6	Female	Nyanga	7750	2016/04/20	2016	4	20	02:30:00	2	Home	6.6	2016/04/20	2016	4	20

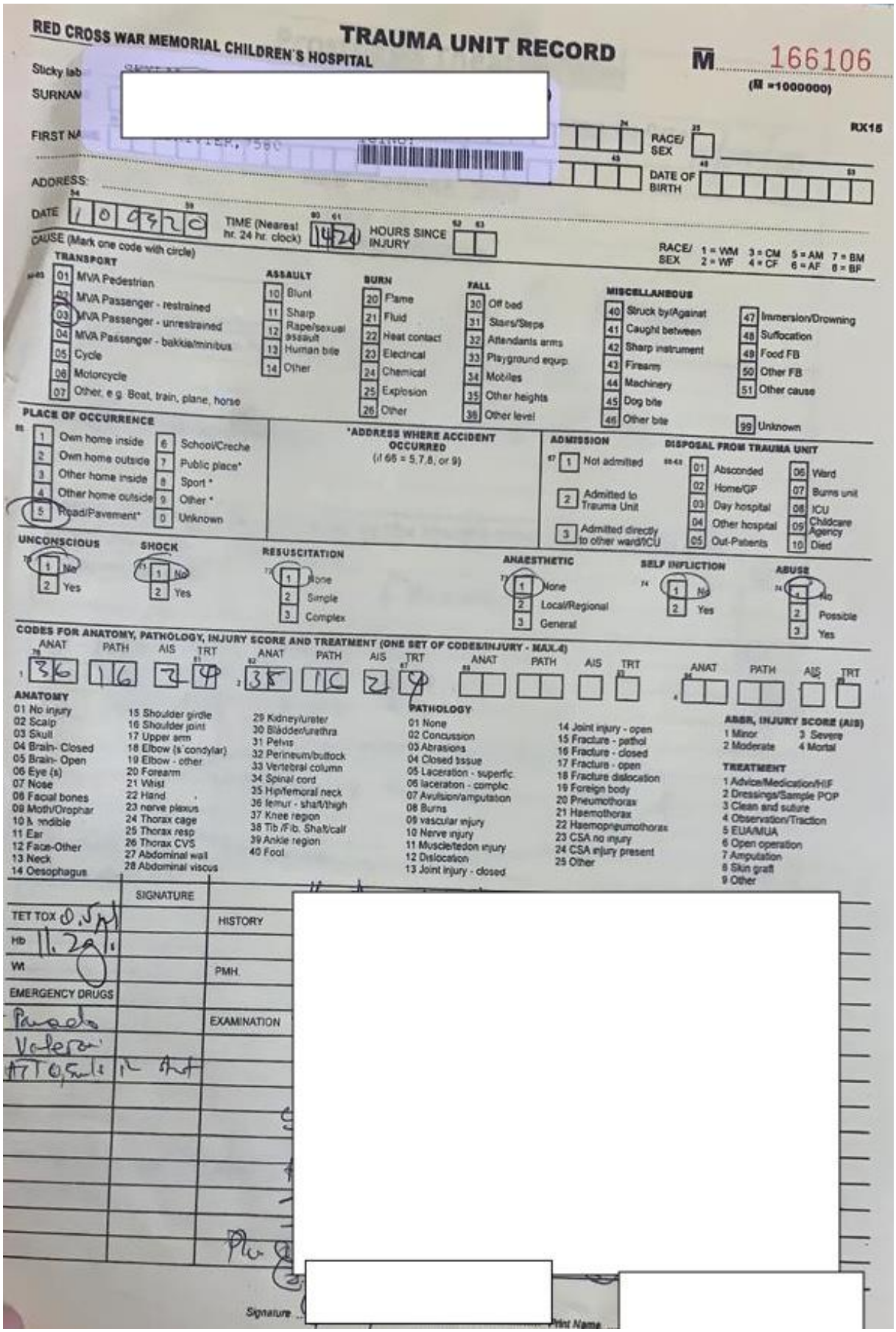
Weekday (I	Time of Inj	date / time	date / time	Time since	days	hours	minutes	Hours since	Hour of inj	Time since	Injury Addr	Type of Fir	Number of	Circumstar	Circumstar	Circumstar	Circumstances	Qualifie
3	08:10:00	########	########	########	0.00	1.00	0.00	1.00	8	01:00:00		Unknown	x	Intentional				
6	18:00:00	########	########	########	0.00	1.00	30.00	1.50	18	01:30:00		Unknown	1	Cross fire				
3	18:00:00	########	########	########	0.00	2.00	20.00	2.33	18	02:20:00		Unknown	1	Cross fire				
5	20:00:00	########	########	########	0.00	2.00	0.00	2.00	20	02:00:00		Unknown	1	unknown				
2	20:45:00	########	########	########	0.00	1.00	0.00	1.00	20	01:00:00		Unknown	x	unknown				
5	16:00:00	########	########	########	0.00	8.00	20.00	8.33	16	08:20:00		Unknown	1	Cross fire				
3	00:30:00	########	########	########	0.00	2.00	0.00	2.00	0	02:00:00		Unknown	3	unknown				

Site of Inju	Injury Site	Injury Site	Injury Site	Injury Site	Injury Site	Number of	Structure I	Structure I	Structure I	Structure I	Structure I	Structure I	Total Struc	Non-Surgic	Admission	Complicatic	Complicatic	Complicatic
Chest, Heac	Chest	Head					Brain	Brain						Resuscitatic	No	x		
head	Head						Brain	Brain						Resuscitatic	ICU	Hospital Ac	Hospital Ac	subglottic
head	Head						Brain	Brain						Observatior	Ward	None		
head	Head						Brain	Brain						Observatior	Ward	None		
Head	Head						Brain	Brain						x	ICU	x		
head	Head						Brain	Brain						Resuscitatic	ICU	Surgical Sit	Surgical Site Infection	
head, Uppe	Head	Upper Arm	Upper Leg				Brain	Brain						Observatior	ICU	Recurrent M	Recurrent Meningitis	

Complicatic	Complicatic	Complicatic	Surgery	Theatre ep	Theatre epi	Theatre epi	Theatre epi	Theatre epi	Theatre Epi	Theatre Epi	Subsequent	Morbidity	Morbidity 1	Morbidity 2	Morbidity 3	Death	Date of Dis
			x	x								None				yes	2011/05/18
			Yes	ICP Monitor	ICP Monitc			Tracheostor			Neurosurg	TBI sequela	TBI sequela	Paralysis		no	2012/11/16
			Yes	Craniotomy	Craniotomy							None				no	2013/05/03
			Yes	Neurosurgic	Neurosurg						Neurosurg	TBI sequela	TBI sequela	epilepsy		no	2014/08/07
			yes	ICP Monitor	ICP Monitc							x				yes	2015/02/06
			Yes	Craniotomy	Craniotomy						Neurosurg	None				no	2016/04/11
			Yes	ICP Monitor	ICP Monitor						Neurosurg	None				no	2016/06/06

Days Admi	Number of	ICU discha	ICU admiss	ICU days	Date of De	Link	Other Notes
0.00	x			0	2011/05/18		
62.00	1	2012/10/03	2012/09/15	18		https://docs.google.com/forms/d/e/1FAIpQLSeXKVyFrnF6GrmavO28PfjSUiMF8jtRkBpoqaUrfe6bVjVT0w/viewform?edit2=2_ABaOnuc0H2doggMiE	
2.00	1			0		https://docs.google.com/forms/d/e/1FAIpQLSeXKVyFrnF6GrmavO28PfjSUiMF8jtRkBpoqaUrfe6bVjVT0w/viewform?edit2=2_ABaOnud7_Xqs9vXh5	
6.00	1			0		https://docs.google.com/forms/d/e/1FAIpQLSeXKVyFrnF6GrmavO28PfjSUiMF8jtRkBpoqaUrfe6bVjVT0w/viewform?edit2=2_ABaOnueEg7HJAhLRS34WEdJ0hlkI	
3.00	x	2015/02/06	2015/02/03	3	2015/02/06		
10.00	2	2016/04/03	2016/04/01	2		https://docs.google.com/forms/d/e/1FAIpQLSeXKVyFrnF6GrmavO28PfjSUiMF8jtRkBpoqaUrfe6bVjVT0w/viewform?edit2=2_ABaOnudAad-nnPsXF	
47.00		2016/04/24	2016/04/20	4		https://doc	notes of injury admission missing

Appendix 4: ChildSafe Data Sheet



RED CROSS WAR MEMORIAL CHILDREN'S HOSPITAL

TRAUMA UNIT RECORD

M 166106

(M =1000000)

RX15

RACE/SEX

DATE OF BIRTH

ADDRESS

DATE 1 0 9 7 0

TIME (Nearest hr. 24 hr. clock) 1420

HOURS SINCE INJURY

CAUSE (Mark one code with circle)

RACE/SEX 1 = WM 2 = WF 3 = CM 4 = CF 5 = AM 6 = AF 7 = BM 8 = BF

TRANSPORT
01 MVA Pedestrian
02 MVA Passenger - restrained
03 MVA Passenger - unrestrained
04 MVA Passenger - bakkie/minibus
05 Cycle
06 Motorcycle
07 Other, e.g. Boat, train, plane, horse

ASSAULT
10 Blunt
11 Sharp
12 Rape/sexual assault
13 Human bite
14 Other

BURN
20 Flame
21 Fluid
22 Heat contact
23 Electrical
24 Chemical
25 Explosion
26 Other

FALL
30 Off bed
31 Stairs/Steps
32 Attendants arms
33 Playground equip
34 Mobiles
35 Other heights
36 Other level

MISCELLANEOUS
40 Struck by/Against
41 Caught between
42 Sharp instrument
43 Firearm
44 Machinery
45 Dog bite
46 Other bite
47 Immersion/Drowning
48 Suffocation
49 Food FB
50 Other FB
51 Other cause
99 Unknown

PLACE OF OCCURRENCE
1 Own home inside
2 Own home outside
3 Other home inside
4 Other home outside
5 Road/Pavement*
6 School/Creche
7 Public place*
8 Sport *
9 Other *
0 Unknown

*ADDRESS WHERE ACCIDENT OCCURRED (if 66 = 5,7,8, or 9)

ADMISSION
1 Not admitted
2 Admitted to Trauma Unit
3 Admitted directly to other ward/ICU

DISPOSAL FROM TRAUMA UNIT
01 Absconded
02 Home/GP
03 Day hospital
04 Other hospital
05 Out-Patients
06 Ward
07 Burns unit
08 ICU
09 Childcare Agency
10 Died

UNCONSCIOUS 1 No 2 Yes

SHOCK 1 No 2 Yes

RESUSCITATION 1 None 2 Simple 3 Complex

ANAESTHETIC 1 None 2 Local/Regional 3 General

SELF INFLICTION 1 No 2 Yes

ABUSE 1 No 2 Possible 3 Yes

CODES FOR ANATOMY, PATHOLOGY, INJURY SCORE AND TREATMENT (ONE SET OF CODES/INJURY - MAX.4)

	ANAT	PATH	AIS	TRT
1	36	16	2	9
2	35	1C	2	9
3				
4				

ANATOMY
01 No injury
02 Scalp
03 Skull
04 Brain- Closed
05 Brain- Open
06 Eye (s)
07 Nose
08 Facial bones
09 Moth/Orophar
10 Mandible
11 Ear
12 Face-Other
13 Neck
14 Oesophagus
15 Shoulder girdle
16 Shoulder joint
17 Upper arm
18 Elbow (s`condylar)
19 Elbow - other
20 Forearm
21 Whist
22 Hand
23 nerve plexus
24 Thorax cage
25 Thorax resp
26 Thorax CVS
27 Abdominal wall
28 Abdominal viscus
29 Kidney/ureter
30 Bladder/urethra
31 Pelvis
32 Perineum/buttock
33 Vertebral column
34 Spinal cord
35 Hip/femoral neck
36 femur - shaft/thigh
37 Knee region
38 Tib /Fib. Shaft/calf
39 Ankle region
40 Foot

PATHOLOGY
01 None
02 Concussion
03 Abrasions
04 Closed tissue
05 Laceration - superfic
06 laceration - complic
07 Avulsion/amputation
08 Burns
09 vascular injury
10 Nerve injury
11 Muscle/tedon injury
12 Dislocation
13 Joint injury - closed
14 Joint injury - open
15 Fracture - pathol
16 Fracture - closed
17 Fracture - open
18 Fracture dislocation
19 Foreign body
20 Pneumothorax
21 Haemothorax
22 Haemopneumothorax
23 CSA no injury
24 CSA injury present
25 Other

ABBR. INJURY SCORE (AIS)
1 Minor
2 Moderate
3 Severe
4 Mortal

TREATMENT
1 Advice/Medication/H&F
2 Dressings/Sample POP
3 Clean and suture
4 Observation/Traction
5 EUA/MUA
6 Open operation
7 Amputation
8 Skin graft
9 Other

	SIGNATURE	
TET TOX 0.5ml		HISTORY
Hb 11.2g/l		
Wt		PMH
EMERGENCY DRUGS		
Panado		EXAMINATION
Voltaren		
ATT 0.5ml IM Ant		

Signature

Print Name

Appendix 5: DRC Approval

UNIVERSITY OF CAPE TOWN

Department of Surgery
Departmental Research Committee
A/Prof Maritz Laubscher
Groote Schuur Hospital
Observatory 7925
South Africa
Tel (021) 404 5108
Email: maritz.laubscher@uct.ac.za

3 Mar 2023

Dr F Verfuss

Department of Surgery
University of Cape Town

Dear Dr Verfuss

RE: Project 2023/026

PROJECT TITLE: Paediatric And Adolescent Civilian Gunshot Injuries: A 10 Year Epidemiological Study

The above protocol has been reviewed by the Department of Surgery Research Committee. I am pleased to inform you that the committee approved the scientific merit of the study, and endorse the protocol for submission to the relevant ethics committee.

Although this letter serves as confirmation that the above protocol has successfully passed through the surgical DRC, respective ethics committees still require DRC chair signature before submission.

Please use the above project number in all future correspondence,

Yours sincerely

Signed by candidate

A/PROF MARITZ LAUBSCHER
CHAIR SURGICAL DRC

"OUR MISSION is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society."

Appendix 6: Ethics Approval

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

Room 45 E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-submissions@uct.ac.za
Website: www.health.uct.ac.za/home/human-research-ethics

26 May 2023

HREC REF: 331/2023

Prof S Maqungo
Division of Orthopaedics
H49, OMB
Email: sithombo@msn.com
Student: frances.verfuss@gmail.com

Dear Prof Maqungo

PROJECT TITLE: PAEDIATRIC AND ADOLESCENT CIVILIAN GUNSHOT INJURIES: A 10 YEAR EPIDEMIOLOGICAL STUDY-
(MMED CANDIDATE-DR FRANCES VERFUSS)

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

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

Approval is granted for one year until the 30 May 2024.

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 if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Dr Frances Verfuss will also be involved in this study.

Please quote HREC REF 331/2023 in all your correspondence.

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

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

Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007

HREC/ref 331.2023

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2020), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines. The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

HREC/ref 331.2023

Appendix 7: Ethics Renewal Approval

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30.05.2025
☐ Not approved	See attached comments		
Signature Chairperson of the HREC	Signed by candidate	Date Signed	30/5/2024

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	27/05/2024		
HREC REF Number	331/2023	Current Ethics Approval was granted until	30/05/2024
Protocol title	**Paediatric and Adolescent civilian gunshot injuries: A 10-year epidemiological study**		
Principal Investigator	Prof Sithombo Maqungo		
Department / Office Internal Mail Address	**Division of Orthopaedic Surgery** H49 OMB Groote Schuur Hospital Observatory 7925 Cape Town - South Africa Telephone: (-27-21) 406 6157/ 8 Telefax: (-27-21) 447-2709 e-mail: sithombo@msn.com		
1.1 Does this protocol receive US Federal funding?		☐ Yes	☐ ✓ No

2. Protocol status (tick ✓)

☐✓	Research-related activities are ongoing
	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval		236
Total number of records or specimens collected, reviewed or stored since last progress report		
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	☐ Yes	☐ No

4. Signature

Signature of PI		Date	27/05/2024

Appendix 8: Institutional Approval

Western Cape Government

Department of Health and Wellness
DR M SALIE
Acting Manager: Medical Services
Red Cross War Memorial Children's Hospital

Queries: Ellen.Thomas@westerncape.gov.za
Tel: +27 21 658 5383

Date: 16 August 2023

Dr F Verfuss
Division of Orthopaedic Surgery

Dear Dr Verfuss

RESEARCH: RXH: RCC 383 / WC_202307_030

PROJECT TITLE: Paediatric and Adolescent civilian gunshot injuries: A 10-year epidemiological study

Thank you for submitting your study to the Red Cross War Memorial Children's Hospital Research Committee for review.

It is a pleasure to inform you that the Red Cross Children's Hospital Research Committee has formally approved your application to conduct above-mentioned study.

Approval is granted until **30 May 2024** as per your ethics approval **HREC 331/2023.**

Kindly submit a renewal request if your study continues beyond the approval period with a progress report. If the study is completed within the approval period, please inform the committee. A copy of your final document to be submitted after completion of your project.

Kindly quote the reference **RXH: RCC 383 / WC_202307_030** in all your correspondence.

Yours sincerely,

Signed by candidate

DR M SALIE
ACTING MANAGER: MEDICAL SERVICES