Epidemiological review of paediatric firearm injuries and mortalities in Cape Town

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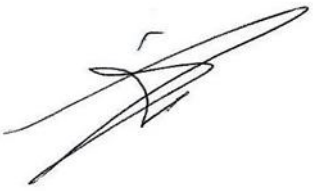
Declaration

I, Dr. **Shadi Sammour**, hereby declare that the work contained in this dissertation is my original work and that I have not previously submitted it, in its entirety or in part, at any university for a degree.



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Abstract

Introduction

Firearm-related violence in South Africa is clearly identified as one of the leading causes of fatal and non-fatal injuries. The South African Firearms Control Act was enacted in 2000 and came into force in 2004 with the aim of ensuring that firearm acquisition processes and procedures were strictly controlled in order to reduce crimes involving firearms.

In South Africa, there are very few studies dedicated to surveying firearm-related injuries in children. Therefore, it is vital that additional information be provided to cover this knowledge gap.

The main aim of this study was to describe the clinical epidemiology of firearm-related injuries and mortalities among children in the Cape Town metropolitan area. In addition, it compared the injuries and mortality rates before and after the implementation of the Firearms Control Act.

Methodology

This study reviewed the medical and mortuary records of children with firearm-related injuries and deaths in the Cape Town from 1 January 2001 to 31 December 2011. The hospital data were retrieved from databases for the two main paediatric hospitals in the metropolis, while the mortuary data were collected with the aid of the Division of Forensic Medicine at the University of Cape Town and its counterpart at Stellenbosch University. The extracted data included demographic details of the children, circumstances of injury, anatomical and pathological patterns, treatment and morbidity.

To assess the effect of the Firearms Control Act on the incidence of child injuries and deaths due to firearms, a comparison was undertaken between the injury and mortality data from four years before and four years after the Firearms Control Act was introduced. The time periods are from 1 January 2001 to 31 December 2004 and from 1 January 2008 to 31 December 2011 respectively.

Results

Boys within the age group of 6-12 years were more affected by firearm-related violence compared to girls. Also, this study revealed that a majority of the children were victims of unintentional single shootings which typically occurred outdoor either in close proximity to their houses, roads or pavements. The majority of the injuries involved extremities, particularly to the lower limbs, with the head and the chest being identified as the most common sites of injury in fatalities. Injuries were mostly mild to moderate in severity and typically included superficial (38%) and complicated lacerations (24%).

Of the 101 children (54% of the total injuries) admitted to hospital, the majority (68) were sent to the trauma ward while 13 children were admitted to the ICU. The remaining 20 children were admitted to other wards and operating theatre. Surgical intervention was required for 40% of the patients. During the study period, firearm-related injuries involved almost 586 days of hospitalisation, out of which 81 days were in the ICU. Hospital stays were primarily due to injuries involving the head (32%) and abdomen (25%).

Firearm-related injuries and deaths seemed to decrease during the study period. However, it was concluded that the law had no effect in the decline, as this decreasing trend of injury and death rate that was observable prior to 2004 continued at the same rate throughout the rest of the decade.

Conclusion

While, the number of injuries and deaths related to firearms decreased during the last eleven years, the trend in injury and death rate that was observable prior to 2004—before the implementation of the Firearm Control Act—continued at the same rate throughout the rest of the decade.

This study identified certain groups of children at certain places who are commonly victims of unintentional shootings. The data derived from the study can be used to target firearm-related injury prevention strategies

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1 Introduction

1.1 Background

South Africa is known internationally for being a society plagued by a high incidence of extreme violence. The high homicide rates prevalent in the country have contributed to this reputation. A rate of 64.8 homicides per 100,000 people makes South Africa the leading homicide country in the world—ahead of Colombia which has 60 homicides per 100,000 people. [1, 2] After HIV-AIDS, injuries related to violence are the second highest cause of death in South Africa. The death rate in this category is nearly twice the international average. [3-5]

Firearms are often used in violence. It is estimated that approximately 15,000 individuals lose their lives every year as a result of gun-related violence. [6] This translates into South Africa ranking third in the annual firearms death rate (26.8 per 100,000 people), after Columbia and Venezuela. [7, 8] Beside the fatalities, nearly 127,000 victims seek medical care at the national hospitals annually because of injuries related to firearms. [6]

To gain a better understanding of the context of firearm violence in the country, it is vital to review the history of violence in South African society and to explore what drives the desire to commit violent acts. The sections that follow below also present the problem of the proliferation of firearms, and the consequent emergence of the new Firearm Control Act in 2004 as an effort to eradicate the problem.

1.1.1 Apartheid-related violence

Violence in South Africa is not new. It is recorded back to 1652 where it was a feature of European colonization and the imposition of a white segregationist regime over the African population majority. It then characterized the urbanisation process following the discoveries

of minerals in the 1880s. In the early 20th century, unemployment in the urban areas became a feature of the South African landscape, which in part drove the emergence of gangs comprising young males. Violence characterised the formation of gang identities that "valorised" the strong and violent man.

Violence after that was a feature of the political rivalry in 1980s and early 1990s which again created new opportunity and model for the "hero character" especially amongst youth. [9]

1.1.2 Post-Apartheid violence

The protracted liberation struggle, characterized by state-sponsored oppression and political violence, ended with the establishment of a new non-racial democracy in 1994. However, the state-sponsored oppression left a legacy of substantial challenges, many of which still persist today. These challenges contributed significantly to the present high levels of violence in the country. [1]

Social inequality, unemployment, and poverty, are among the central socioeconomic dynamics that contribute to the high burden of violence. The redistribution of income and wealth has been among the priorities of the new government since 1994. However, the macroeconomic policies have contributed to the persistence and even growth of economic disparities between races.[10] The Gini Coefficient (a marker of social inequality) increased from 0.56 in 1995 to 0.64 in 2009 which is amongst the highest in the world. [4]

A thorough analysis of the association between socioeconomic inequalities and violence according to a data survey on 63 countries, demonstrates that violence is strongly correlated with income inequality. South Africa ranked top on the income inequality and the homicide rate among the 63 countries studied. [4, 11]

Following income inequality, unemployment (particularly youth unemployment as is the case in South Africa) is most correlated with high levels of violence. Over a quarter of the South African's population is unemployed. [12]

Lastly, poverty also represents strong barriers to access of common bases of wellbeing and respect. This can consecutively result in negative feelings of embarrassment, disgrace, and a loss of self-esteem. Where there is excessive poverty, inequality, and unemployment in the community, there is likely to be anger and frustration, and therefore violence might be used to gain the power and resources that others have. This condition is more serious in urban regions epitomised by dense populations, rapid urbanisation, poor communal cohesion, and inadequate housing. [13]

These dynamics are inseparably linked with other important drivers that include a broken family constitution and weak parenting skills; a notion of patriarchal masculinity valorising the defence of honour; the encouragement of risk-taking and toughness; and, alcohol and drug abuse. All these, together, contribute to the proliferation of violence. [4]

1.1.3 The changing patterns of violence

Gang Violence

The social and economic instability following the political transformation presented an ideal environment for the outbreak of the criminal activity. This setting enhanced extensive gang activities allied to the larger, major gangs. Correspondingly, opening the borders in 1994 presented international crime syndicates an opportunity to move rapidly into the country and to take root. Within a short period thereafter, there were various international crime syndicates operating in South Africa. By 2004 the South African Police Service (SAPS) announced that there were 341 different organised crime syndicates operating in South

Africa. [9] They were engaged in various forms of crime: trading in drugs; cars theft; armed robbery; and, high-jacking.

The arrival of crime syndicates has had a major influence on the existing gangs in South Africa, particularly in Cape Town. Gangs reorganized themselves, and formed alliances called cores. [9] Small gang groups joined larger gangs and became active in more sophisticated illegal operations, chiefly drugs. This often led to conflict between various gang groups, with youngsters involved in running fights in the streets.

Firearms are typically used in these battles which frequently threaten communities. Fighting is erratic and random. Thus, on many occasions, fighting results in shooting innocent bystanders like children. In addition, it disrupts access to common services like transport, hospitals, and schools. These activities are noticeable mostly in the Cape Flats areas of the Western Cape which includes the largest number of gangs in the City of Cape Town. In 2000 SAPS estimated 137 gang groups in the Cape Flats with around 80 000 to 100 000 members. [9, 14]

Xenophobia

Violent xenophobic attacks represent another significant aspect of widespread violence in South Africa. Xenophobia is a negative attitude towards foreigners. [15] It is not a new phenomenon, but increased after the first free election in 1994 when the country was re-integrated into the international community. In South Africa, especially in Cape Town and Johannesburg, there are reports of widespread cases of serious xenophobic harassment and attacks. These left many foreigners with a range of injuries, many of which were firearm-related. Xenophobic attacks have caused distress in mostly black, non-South Africans. Many in this population group have decided to return to their country of origin to escape

xenophobic violence. Xenophobic attacks peaked in 2008, when they were responsible for more than 62 fatalities and over 20,000 cases of displaced persons. [16]

The South African Human Sciences Research Council has described three main driving factors for this form of violence:

- Relative deprivation which results in extreme competition with other African nationals for jobs, resources, supplies ,and accommodation;
- South African exceptionalism: a feeling of superiority over other Africans nationals
- Exclusive citizenship or a form of nationalism that excludes others. The South African national sensibility creates exclusivist tendencies towards others. [16]

1.1.4 The transformation of the criminal justice system

The explosion of violent crime occurred at a time of transition when the new democratic government was still mapping a new, reformed, criminal justice system to replace the old apartheid system. The scope of the reformation was wide and the burden on the "young" government was heavy. The first years of transformation in particular were slow: there was a great deal of confusion and mistrust. The criminal justice system was believed by the public to be ineffective and insufficient in providing justice and security. [17] There was distrust in the system in the community and therefore people turned to other private resources to secure their safety. [17] This motivated, among other things, an escalation in the demand to own firearms.

1.1.5 Firearms proliferation

The terms 'gun' and 'firearm' is used interchangeably in this dissertation. For the purposes of this dissertation, I use the term firearm to include "any weapon which will, or is designed to, or may readily be converted to expel a projectile by the action of an explosive". [18] Firearms

can be broadly divided into two main categories: handguns and long guns. Handguns can be held or fired with one hand (e.g., a pistol or revolver), while long guns need two hands to hold or fire (e.g., rifles or shotguns).

In the context of social and economic instability alongside political transformation, it is not surprising to see a massive proliferation of firearms in the country. Between 1999 and 2005, the number of registered firearms in the country (which are more likely to be used by civilians for protection) almost doubled from 4.04 to 7.87 per 100 people. [19] The actual number of illegal firearms in the country (which are most likely to be used in committing violent acts) is unknown. There are some reports that broadly estimate that there are 8.42 illegal firearms per 100 people. [19]

The first source of illegal firearms is internal to the country: large numbers of illegal firearms stem from stolen firearms or firearms lost by licensed civilian owners, state personnel, or state armouries. [20] The second source is external: these firearms are obtained from outside the country's national borders. These weapons were part of the arsenal of liberation and civil wars in neighbouring countries, especially Angola and Mozambique Many illegal weapons, especially automatic rifles, were smuggled from these countries. [20] With this proliferation of illegal firearm ownership, it is understandable why it is difficult to accurately predict the quantity of illegal guns in circulation in South Africa. It is essential to note, however, that the number of illegal firearms keeps growing annually as formerly legal firearms find their way into the illegal pool. [9]

1.1.6 The emergence of the new Firearm Control Act.

Strict firearms control has been recognized as one of the key priorities of the South African government since it was first elected into office in 1994. This was demonstrated through a number of actions that were aimed at reducing the number of legal and illegal firearms

circulating in the country, thus ensuring that illegal firearms would not end up in criminals' hands.

In the same way, the proliferation of both legal and illegal firearms, with the consequent high incidence of gun-related deaths and injuries, gave rise to several non-governmental organisations and civil society movements. Anti-gun lobbies developed a number of campaigns aimed to engage the government in administering rules and regulations to control the sources that drive the supply and demand for firearms and correct community attitudes towards firearms.

These efforts contributed to the emergence of the Firearms Control Act which was passed in 2000 and promulgated in July 2004 after strong resistance from the pro-firearm lobby (i.e., firearms owners and firearms manufacturers). [21] This 2004 law is aimed at implementing stricter controls over legal weapons through additional licensing procedures. It mandates that applicants—who must be at least 21 years old—be subjected to a competency test, a demand that involves a basic training course and background checks by the South African Police Services (SAPS). [22] The law also requires the regular renewal of any firearm licence. The licence renewal for existing licence-holders was designed to be phased in according to a schedule that extended over a five-year period (2004-2009). [22]

Although some argue that the Firearms Control Act has only served to increase the number of illegal guns found on the black market, the law gives the police and courts greater power to deal with illegal firearms. For example, in accordance with the 2004 Act, it is a criminal offence to know that an illegal firearm is on a property and not report this to the authorities.

South Africa has made progress in reducing the number of firearm-related deaths in the country; however, firearm-related deaths and injuries are still common. [23-28]

Children are not excluded from this violence. During the period 2001–2005, an average rate of 128 homicides per year was recorded against children under the age of 15: firearms were found to be the leading cause of these homicides. [23] This is in stark contrast to most other countries where cancer and motor vehicle-related accidents are the foremost causes of death in the same age group. [24**]**

1.2 Motivations for the study

This epidemiological review of paediatric firearm-related injuries and fatalities in Cape Town is of significant importance. In this section, I describe the motivation behind conducting this study with reference to the following points: the need for studies about children; the dearth of data in South Africa on paediatric firearm-related injuries and deaths; the role of health professionals; and, the significance of gun-related injuries in emergency medicine.

1.2.1 The need for studies about firearm injuries and deaths in children

Firearm-related injuries have long been a major issue of concern worldwide in the public health sector. Improved surveillance in the past few years has led to several population-based studies monitoring fatal and non-fatal firearm-related injuries, focusing on teenagers and adults. However, if we consider the anatomical and physiological distinctions between young children, and teenagers and adults, the injury pathology, severity, and outcomes, are expected to be different. Moreover, the risk factors and the circumstances associated with gun-related injuries in children are considerably different; as such, the preventive strategies for this younger age group are likely to be different. In light of these differences, studies aimed at children should be also encouraged and not overlooked.

1.2.2 The dearth of data in South Africa

There is a scarcity of literature related to the clinical epidemiology of firearm-related injuries in children living in South Africa. The international data on the other hand can't be directly used due to the disparate socio- economic and political background in South Africa.

The lack of studies has led to an information vacuum that hinders the development of services, standards, and policies, to address firearm-related violence against children. The effective collection of data detailing the comprehensive causes of death and injury can play a substantial role in the control and management of trauma and injuries. Such material forms an important component of health information systems and assists hospitals, governments, and relevant associations in identifying the major causes of premature mortality while still highlighting the varied health needs within a society. To this end, it is imperative that the supplementary information should be offered to improve our knowledge of the epidemiology and the clinical impact of such injuries.

Furthermore, local studies devoted to the epidemiology and clinical outcome of gun-related injuries in children are restricted to the examinations of cases at individual hospitals. [25, 28] This study differs from previous ones in that it is a more comprehensive assessment involving firearm-related injuries and fatalities in children residing in Cape Town

1.2.3 The role of health professionals

Firearm violence, other than being a critical socioeconomic problem, is considered a significant public-health problem. Firearm violence was previously considered a criminal justice and law enforcement problem. Recently, however, it has been acknowledged that health professionals can play a crucial role toward stemming firearm violence beyond their role in managing the medical and psychological trauma that ensues from firearm injuries [18]. While the police and criminal justice approach is chiefly reactive, the approach by the

health-care sector is characterised by its contribution in developing preventive strategies against firearm violence.

In order for the various stakeholders such as Western Cape Government, SAPS and public safety administrators to formulate sustainable and appropriate approaches towards the prevention of firearm-related violence in children, it is crucial to understand why, how, when and where, children fall victim to injuries from firearms. This research can add valuable data and information related to firearm injuries and fatalities.

1.2.4 Firearm-related injuries in emergency medicine

Existing studies demonstrate that firearm-related injuries have a wide spectrum of patterns, ranging from superficial lacerations to more serious, even fatal outcomes. Furthermore, patients in the paediatric age group with such injuries are particularly at risk for poor outcomes, due to the relatively small volume of space in which their vital organs exist. [24] Since Emergency Centres (ECs) are typically the initial places of medical contact for victims of injuries related to firearms, it is essential for emergency-care providers to be updated with the epidemiological and clinical data related firearm injuries.

2 Literature review

2.1 Introduction

Firearms play a significant role in the high rate of violence in Cape Town. [1] Children and young adolescents are not excluded from gun-related violence.

This review seeks to examine several existing international and South African studies on the topic of firearm-related injuries and mortalities amongst children. The review is structured into principal sections involving major relevant themes discussed in the literature. The first section will review the magnitude, the determinants, and the impact of firearm violence, from both an international and South African perspective. The second section will focus on the firearm violence against children. It will look at its magnitude, and review the epidemiology and outcomes of firearm related injuries.

2.2 Magnitude of firearm violence

2.2.1 The international perspective

The Global Burden of Armed Violence (GBAV) report, prepared by the Geneva Declaration Secretariat in 2008, investigated the extent of armed violence around the world. It showed that at least 740,000 people die every year as a result of armed violence. [29] The majority (540,000 deaths per year) occur in non-war settings such as in nations blighted by violent crime, weak policing, dysfunctional justice systems, and the misuse of firearms.[29] Non-conflict armed violence includes homicides, suicides, and other forms of injuries and deaths such as violence based on gender or domestic violence.

According to the Geneva Declaration Secretariat [29], non-conflict deaths are usually distinguished from those in conflict areas by means of the killing organization. In homicide,

the perpetrator is usually an individual or small group of individuals; in armed conflict, the killing is committed by organized groups of up to many hundreds of members. But the difference in intensity is frequently minor between small armed conflict and large scale criminal violence. For example, countries such as El Salvador, Jamaica, and South Africa bear a high level of homicide, with annual death rates exceeding many contemporary wars. [30] See Figure 1.

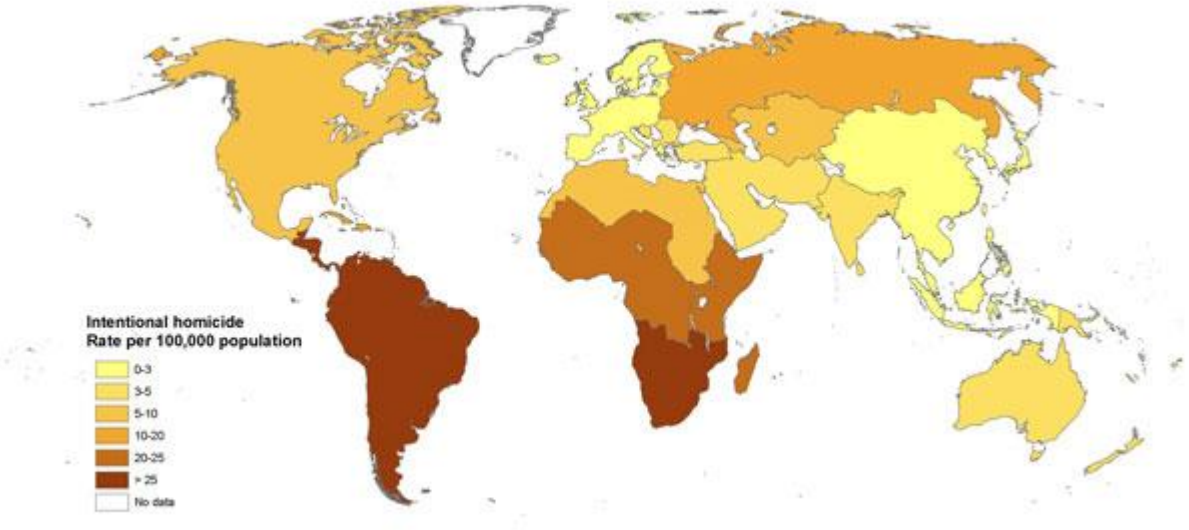

Figure 1 International homicide rate per 100,000 populations by sub region, 2004. [30]

The United Nations Office on Drugs and Crime (UNODC) clarifies that a comparative study of homicide figures should be reviewed carefully since there are variable legal descriptions of homicide between countries [30]. In addition there are variances in the capability, standards, and methods of reporting cases. This is particularly applicable to many developing countries, including South Africa, as the data exhibit considerable discrepancies between police and public-health statistics.

2.2.2 The South African perspective

In South Africa the data on the use of firearms are fragmented. A report by the National Crime Prevention Centre shows that between 1994 and 1998, an average of 25,743 homicides per year were recorded across South Africa, of which 44.4% were committed using firearms.[31] Handguns were the most common type of firearms used in committing homicide. In 1998 handguns accounted for 57.4% of firearm-related homicides. Commercial rifles and shotguns came in next at 24.8%. [31, 32]

After the year, 2000, disaggregated firearms data by the South African government were no longer as publicly available. [32, 33] Trends now must be estimated from data available in media reports, aggregated South African Police Services crime data, other databases such as the National Injury Mortality Surveillance system (NIMSS), Statistics South Africa (Stats SA) and via crime surveys such as the Victims of Crime Survey. [32, 33]

The South African Police Service (SAPS) statistics lack sufficient detail about the use of firearms in committing crimes. They record the illegal possession of firearms and ammunitions. According to their latest report, this crime decreased by 20 % from 36 per 100,000 to 29 per 100,000 between 2004 -2008 at an average rate of 4 % per annum. After that (2009-2011) however, the rate remained almost constant at 29 per 100,000. [34]

According to SAPS data there is an overall reduction in the rate of most forms of violent crime. Violent - or contact - crimes include: murder, attempted murder, sexual offences, assault, and robbery. The rate of contact crime reduced by 35.5% (from 1, 911 to 1, 233 per 100,000) between 2004/5 and 2011/12. Since the use of firearms is prevalent in most violent crimes, the reduction trend in violent crimes might permit the hypothesis of reduction in firearm violence. [35]

Looking more specifically at the homicide rates during the last decade (2002-2012), a reduction by 34% from 47 per 100,000 to 31 per 100,000 is seen. In essence, this figure denotes a further drop of 54% in the homicide rate since 1994, when the rate was 66.9 per 100,000. [35]

Yet, the SAPS are criticized as their statistics are thought to be unreliable and underrepresent the true magnetite of crimes in the country. For example, the homicide rate of 49, 8 per 100 000 reported by SAPS in 2000/2001 is in stark contrast to the rate of 64.8 per 100 000 recorded by other resources. [4]Most of the contention arises because of under-reporting by victims or under-recording by police. A recent report in the media claimed that 60% of the reported crimes to the SAPS call centre do not get recorded and documented and, therefore, are not investigated. [36] SAPS statistics are also criticized as they lack a comprehensive crime code list and therefore some crime categories cannot be classified, for example, gun violence, or domestic violence. [37] Despite these drawbacks, these crime statistics are thought to offer at least some comparable national data with other resources such as NIMSS. [4]

The NIMSS was established by the South African Medical Counsel (MRC) to fill the gap in understanding the causes of unnatural deaths. It is considered the most comprehensive source of information of unnatural causes of death in the country. In addition, NIMSS is the only system that routinely provides detailed information about the weapons used in homicide cases. [4] The information is collected from present medico-legal laboratories and the state forensic laboratories. [38] The continued implementation of surveillance systems remains crucial as they provide trustworthy data in terms of the distribution and scale of firearm-related crime and violence.

Since its inception in 1999, the NIMSS has emphasised the high rate of violence across the country. The 2008 NIMSS report shows that violence still remains the foremost cause of unnatural deaths in the country, accounting for almost one-third (31.5%, n=9831) of the total unnatural deaths, followed by injuries related transport (29.4%, n=9153), unintentional injuries (17.5%, n=5444), and suicides (10.0%, n=3125).[38]

Firearms are often used in violence. Of the 10,000 reported cases of violent deaths in 2008, 1 in 4 people died from injuries related to firearms. [38]

However, looking at the overall trend of firearm related violent death reveals continuing reduction during the last decade. Data shows that the number of firearm-related deaths decreased from 26% (of the total unnatural violent deaths) in 1999 to 14.9 % in 2007. [39] Firearms surpassed all external causes of unnatural violent deaths, including those resulting from sharp objects, strangulation and burns. Since 2007, however, there was a change when sharp force injuries overtook firearms as the primary source of non-natural violent deaths. [39]

More evidence of the declining firearm death is documented by the NIMSS report of 2005.[40] This report compares firearm homicide rates with non-firearm homicides rates for a period of four years between 2001 to 2004 (Fig. 2,3). Although a decline in both groups is presented, there is a considerably quicker reduction in the firearm homicide ($p<0.01$). [40,41]

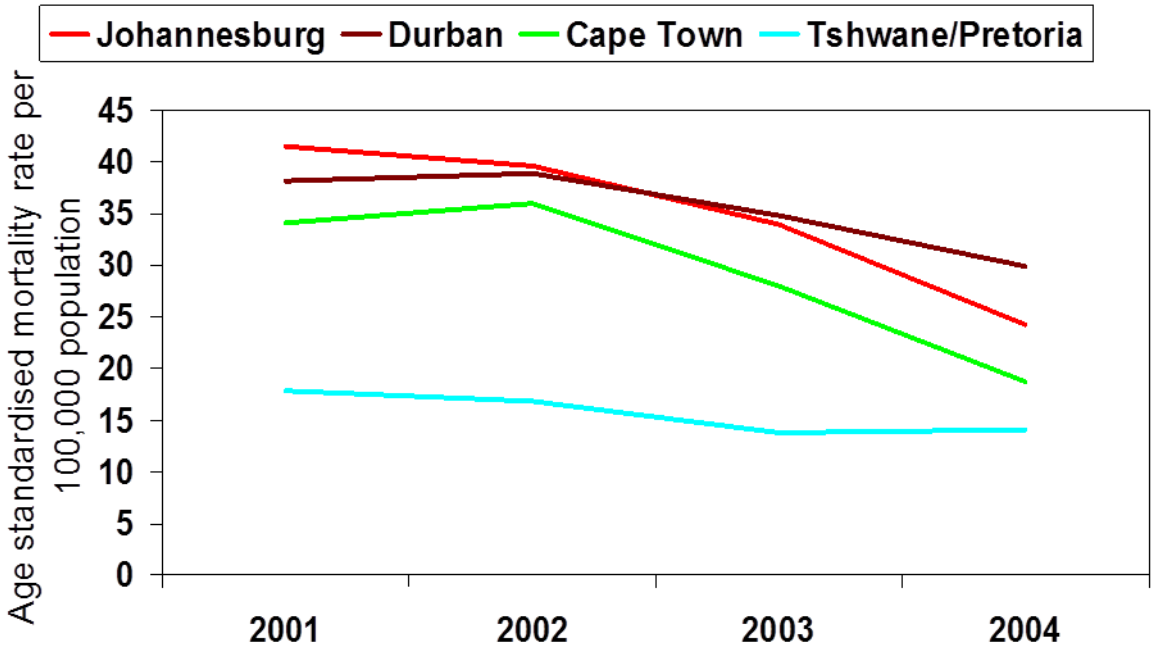

Figure 2 Non-firearm homicide rates in four major cities between 2001 and 2004. [40]

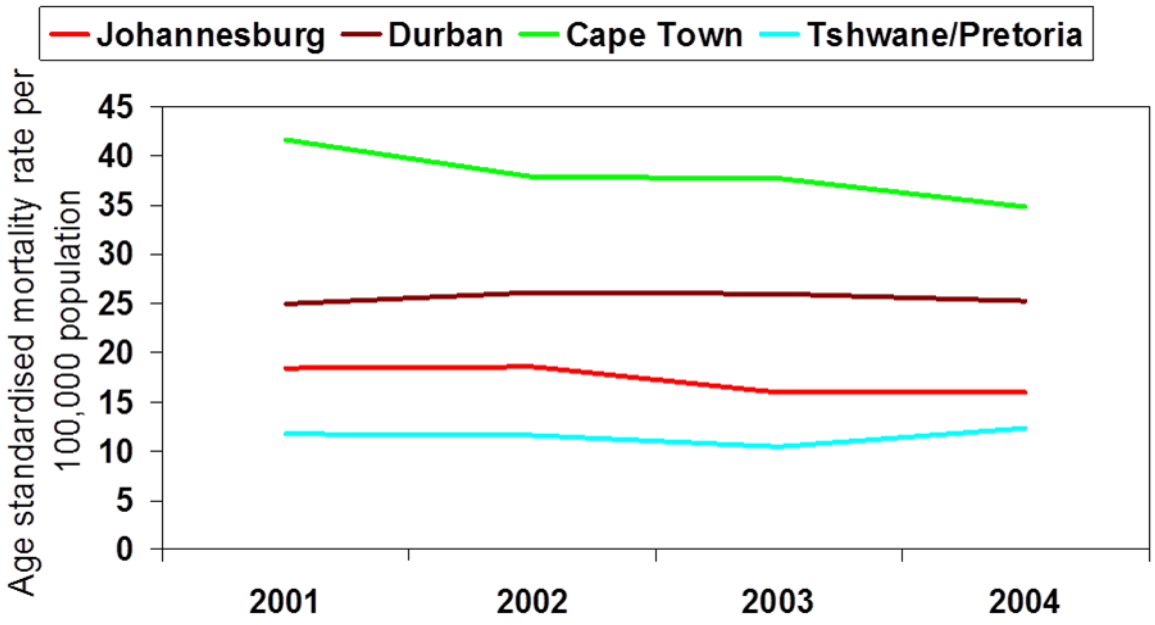

Figure 3 Firearm-related homicide rates in four major cities between 2001 and 2004. [40]

The rate of violent crimes and the use of firearms varies between, and within, cities in the country. [42] Table 1 shows the violent death rates and the firearm-related death rate per 100,000 populations in four major urban areas in 2007.

Table 1 The violent death rate and the firearm-related death rates per 100,000 population in four major urban areas in South Africa.

City	*Violent death rate per 100,000*	*Firearm related violent death Per 100,000*
Cape Town	***63.5***	***20.4***
Durban	***55.9***	***24.5***
Johannesburg	***43.0***	***21.3***
Tshwane (Pretoria)	***30.7***	***13.5***

The variable distribution echoes the large-scale socio-economic disparities with the heaviest burden in the poorer townships of major urban areas. In Cape Town poor zones like Khayelitsha and Nyanga bear extremely high rates of homicides in comparison to other "cold" zones: 451 per 100,000 cases and 485 per 100,000 cases respectively. [1, 43] (See figure 4).

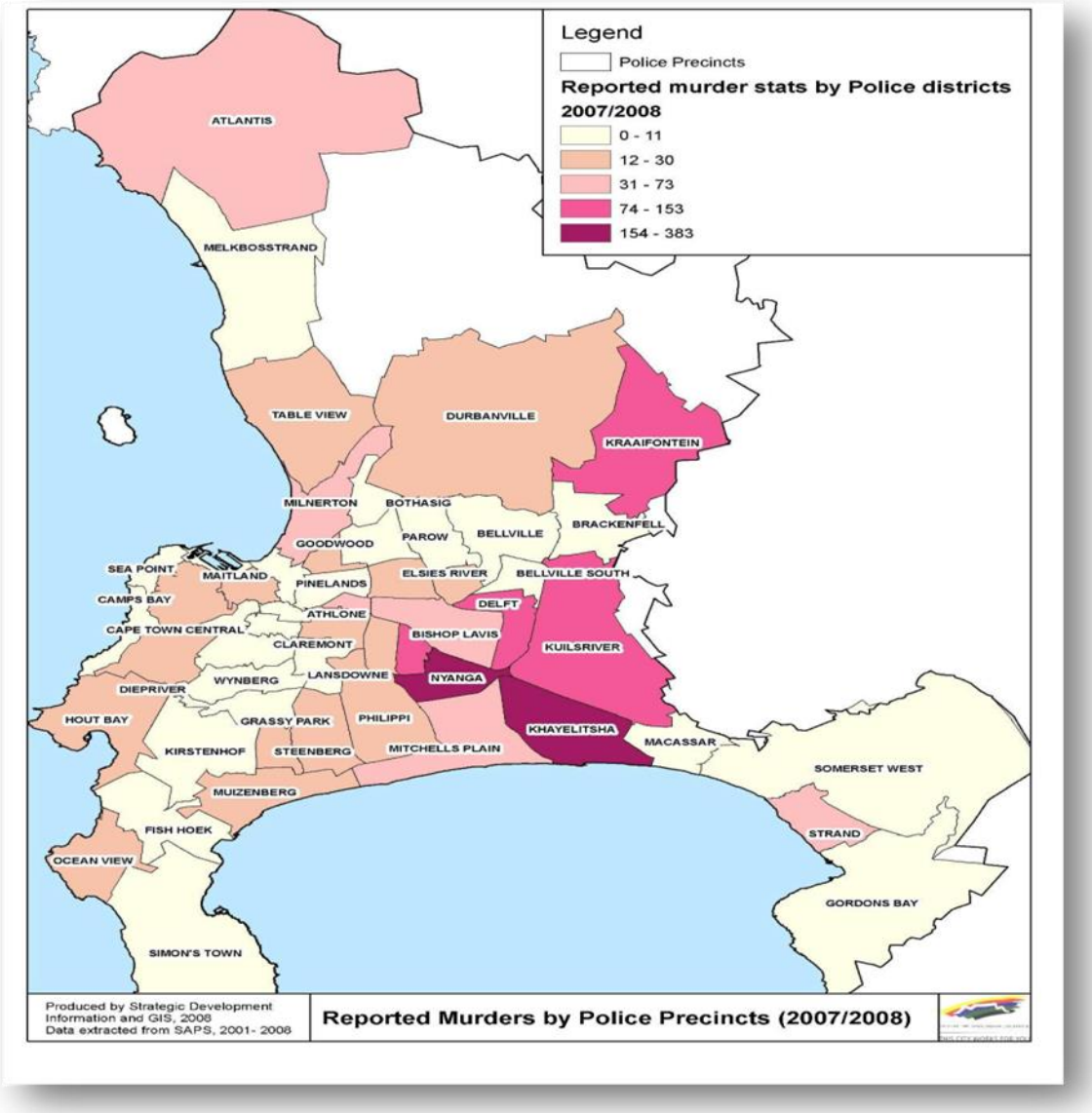

Figure 4 Reported murders in Cape Town by police precincts (2007/2008). [43]

2.3 Determinants of firearm-related violence

An ecological model created by the WHO to understand the roots of violence explains that violence is not the result of just a single factor but a complex interplay of various socio-economic, cultural, political, and individual, features. [44] This explains why there are widely variable rates of violence observed worldwide and how these factors can either mitigate or

exacerbate their effects and shape the experience of firearm-related violence across different settings. The ecological model can be abstracted as four nested circles representing the level of risks to violence. See Figure 5.

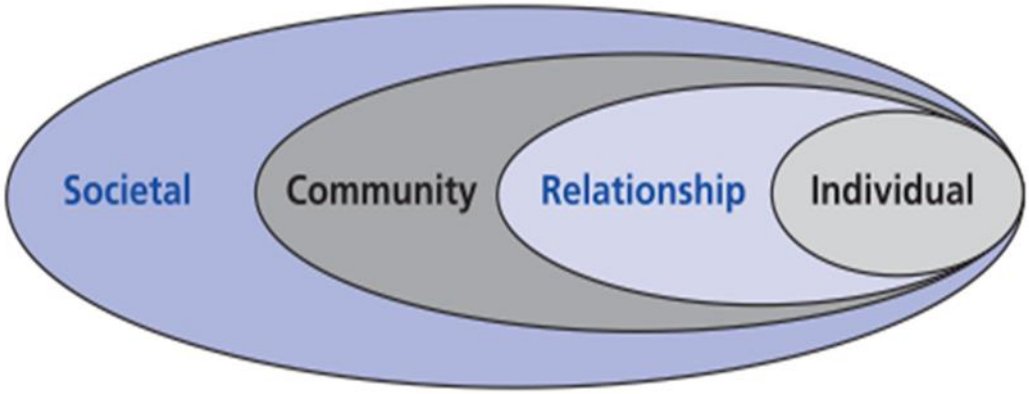

Figure 5 Ecological model for understanding violence.[44]

1) The innermost circle represents the individual risk. It includes the personal factors that influence the individual's behaviour For example, age, gender, and education.
2) The second circle represents the relationship with family and friends, for example, a dysfunctional family, inter-generational violence or relationship with friends who engage in violence behaviour.
3) The third circle represents the risk factors in community institutions, the neighbourhood; school, for example, high population density, social isolation, or a poor sense of community.
4) The fourth, outermost circle is broader factors in the society which reduce inhibition against violence, that is, economic and social inequalities, cultural norms, and a weak legal and criminal justice system.

In South Africa including Cape Town, the surge in firearm use is not the only element in fuelling violence. It is related to other important complex factors as well. Table 2, [45]

summarizes the broad categories that appear to increase the risk of involvement in violent activities.

Table 2 Risk factors for adolescence involvement in violent activities in Cape Town. [45]

Category	***Factors***
Psychological	***Recklessness, bold, low intelligence, fierceness.***
Family	***Cruel treatment from parents, low parental participation, low family consistency, brutal or aberrant kin.***
Lifestyle	***Abuse of drug, alcohol, and other substances; early sexual activity and promiscuity.***
Socio-economic	***Poverty, income inequality; low educational attainment; lack of or poor advancement or employment prospects.***
Community	***High levels of crime in the neighbourhood; exposure to violent adults in the neighbourhood; availability of firearms, drugs, alcohol and other substances.***
Culture	***Norms supporting the use of violence, low religious socialization, risk-taking and appearance of toughness violence begetting violence.***

2.4 The impact of firearm violence

Violence involving firearms, apart from being a key socio-economic challenge, is also a critical challenge to health care systems around the globe. The next section will outline the important aspects of firearm violence impact.

2.4.1 Psychological impact

Far more permeating, yet far less understood, are the psychological impacts of firearm violence on victims. Firearm violence not only affects the individual who has been shot or held at gunpoint, but also has a traumatic effect on relatives, colleagues, and others close to the victim. Buchanan [46] points out that this secondary victimization is frequently overlooked.

Furthermore, most victims, principally in poor communities prevalent with interpersonal violence and crime, go untreated. This makes the potential for a generational cycle of violence, with violence continued by one generation motivating violence in the next.

The impact can be multiple and compound – victims exposed to firearm violence can exhibit various symptoms, involving anxiety, sleep deprivation, marginalisation, and avoidance. These can result in severe impediments in an individual's confidence, well-being, employment prospects, and family connections. [46] In addition, it can result in a loss of capacity, a loss of motivation, alcohol and drug misuse, and immersion in other risk conduct, such as violence and crime.

2.4.2 Economic impact

Estimating the costs of firearm-related violence is a complex procedure. According to Lauren [32], it is useful to perceive the impact of firearm violence from two aspects: direct and indirect costs. Direct costs are the immediate consequences and include the emergency and inpatient medical care costs and the costs of incarceration and legal services. Indirect costs are the secondary consequences of violence involving firearms: these include the loss of employment and productivity, the exhaustion of social and physical assets and a weakened quality of life. [32]

Firearm-related violence negatively impact government resources and development. Responding to constantly to high levels of violence puts pressure on the criminal and justice systems as well as the health care systems, particularly of developing countries whose resources are already stretched quite thinly. This, instead, diverts fiscal resources from much needed public services.

Violence involving the use of firearms influences the perceptions of security within a society. All these consequently have negative impacts on the economy due to losses in foreign and local investments as well as a consequent decrease in productivity. [47]

In developed countries such as the United States, the direct and indirect costs resulting from gun-related violence have been estimated to total US$100 billion per year of which US$15 billion is spent as a result of firearm-related violence against children and adolescents. [48]

The burden is obviously heavier on low and middle income countries. In Colombia and Brazil for example, the direct costs of injuries caused by firearms add up to US$38 million and US$88 million every year, respectively. When the indirect costs are added, the total cost climbs sharply to reach US$4 billion in Colombia and US$10 billion in Brazil—which is equal to 1% and 0.5 % respectively of their GDP for a single year. [49] In Guatemala and El Salvador, costs are even higher. Almost 7.3 % and 14% of their annual GDP is spent on responding to firearm-related violence, respectively. [50, 51]

2.4.3 The cost on the South African health care system

In South Africa, research aimed at evaluating the economic burden of gun-related violence is limited. However, some studies conducted at individual hospitals have attempted to estimate the direct medical costs of treating firearm-related injuries.

For example, a pilot study [52] was conducted in a tertiary hospital in Johannesburg in 2004 to estimate the cost of treating injuries in South Africa. The study found that injuries resulting from gunshots were the most expensive to treat amongst other types of injuries such as those caused by falls, pedestrian motor-vehicle accidents, and burns. On average, injuries resulting from gunshots were treated at US$ 992[53]. These costs reflect consumables only. Consequently, the aggregate direct medical cost associated with the treatment of firearm-

related injuries is immense on the South African public health system when extrapolated to include the entire incidences of such injuries. [52]

A recent study on the cost of gun-related injuries in South Africa—which spends US$863 on health per capita - showed that the average inpatient cost per day was US$385, and that the average cost per patient was US$2,230 [54, 55]. In contrast to the previous pilot study, this study included the cost of the hospital stay, diagnostic imaging and surgical procedures as well.

The cost of providing emergency treatment due to firearm-related injuries has not been estimated to date. A study conducted in 1993 at Groote Schuur Hospital (the largest tertiary hospital in the Western Cape) [56] showed that of the 969 patients admitted with firearm-related injuries, 405 (42%) required emergency surgical operations. The hospital cost of serious abdominal firearm-related injuries was estimated to be about US$ 2600 per case. [57]

Another study, undertaken by Allard et al. [57], focused on the cost of treating serious abdominal wounds caused by gunshots in a district hospital in Cape Town. This study showed that the average inpatient cost is US$ 1,467. Allard et al. estimated the cost of treating these injuries to be thirteen-fold more than the annual per capita government expenditure on health care in 2002. The authors concluded that this resulted in a financial loss of about 4% of the annual budget. [57]

Although the cost appears far less than what developed countries face with greater health expenditure, the key observation with regard to these estimates is that the cost burden of treating firearm-related injuries in South Africa surpasses the national financial resources and overwhelms human resources, which weighs heavily on the state-subsidized health care system. [57]. Bowman et al. [58] believe that the billions of rand spent on medical treatment, administration, and rehabilitation of the victims of violence and firearms-related injuries, may

perhaps be more productive when used for the primary prevention of violence. The goal of such a program is to reduce the fiscal pressure on the already heavily-burdened public health system and thereby improve the overall quality of life.

2.5 Firearm violence in children

Children are the most vulnerable people in a society, and some groups of children are even more vulnerable due to their sex, race, ethnic origin, a physical or mental disability, or socio-economic level. Violence against children happens at any time and in any place. It can take many forms including sexual abuse, corporal punishment, and psychological violence (for example, neglect, maltreatment, or discrimination). Even if the impact varies according to the nature and degree of the violence perpetrated, the short- and long-standing consequences for children are often very serious and destructive. [59]

Firearm-related violence is among the most serious forms of abuse against children. Violent acts where firearms are used are more likely to result in their death than other forms of violence. Even in non-fatal cases, injuries related to firearms are usually far more severe than injuries resulting from other forms violence. The circumstances under which children and adolescents sustain both non-fatal and fatal firearm-related injuries are diverse. Compared to violence involving adults, children, in most incidents, are the victims rather than perpetrators of violence. [60]

This section is a review of the national and international studies related to the magnitude, epidemiology and outcome of firearm-related injuries and deaths in children.

2.5.1 Magnitude of firearm-related injuries in children

Among the developed countries, the US by far exhibits the highest rates of deaths and injuries as a result of firearms among children below the age of 15. [61] A recent report about gun-

related injuries and fatalities among children in the US showed that in 2008 and 2009, 1,234 children under the age of 15 were killed by firearms and another 3,869 sustained non-fatal injuries. [62]

An earlier nationwide survey was conducted in the US between 1993 and 2000 to estimate the fatal and non-fatal firearm-related injuries amongst children under the age of 14 and to scrutinise the nature and circumstance under which these injuries occurred. The survey identified 22,551 children under the age of 14 who sustained firearm-related injuries with an incidence rate of 4.9 per 100,000. [63] The mortality rate was estimated at 1.2 per 100,000 children during the eight-year study period. A more recent study was conducted by Senger *et al.* in a single trauma centre in the US [64]. The study found that 194 children under the age of 18 were admitted to the centre with firearm-related injuries between 1999 and 2010. However, the authors noticed that the incidence of injuries did not change during the study period. [64]

In South Africa the data on the incidence of firearm-related injuries in children are limited. Only one retrospective study investigated the firearm-related injuries in Cape Town but among children *and* adolescents under 19-years old.[27] The study found that between 1992 and 1996, 1,736 children and adolescents sustained firearm-related injuries and 322 (19%) of them died. In essence, it recorded that the incidence of both firearm-related injuries and mortalities nearly tripled during the four-year study period. The increase was from 20.2 per 100,000 in 1992 to 58.1 per 100,000 in 1996 respectively.

In terms of firearm-related deaths, the previous study found that the incidence of firearm deaths almost tripled from 3.8 per 100,000 in 1992 to 10.3 per 100,000 in 1996. [27]

Burrows et al examined the fatal injuries in urbanised South Africa children (0-14 year old), between 2001 and 2003. [65]The authors found variable rates of fatal firearm injuries among

the genders, different population groups, and the major urban areas in South Africa, with the majority of victims being coloured and African males in Buffalo City and Cape Town. (See Table 3)

During the periods between 2001 and 2005, another study using NIMSS data, recorded an average homicide rate of 3.5 per 100,000 for children under age 15 in four urban cities in South Africa.[1] Most deaths were perpetrated with firearms. This was followed deaths by sharp and blunt objects. This was typical in both boys and girls and for all age groups under 15.

Table 3 Number and rate of firearm related deaths per 100,000 according to gender, population groups and city (2001-2003).

Gender	***Number***	***Rate***
Male	***109***	***2,2***
Female	***63***	***1.3***
Population group	***Number***	***Rate***
Indian/Asian	***6***	***1.0***
White	***12***	***1.1***
Coloured	***34***	***1.9***
African	***121***	***1.9***
City	***Number***	***Rate***
Tshwane	***14***	***1.0***
Cape Town	***55***	***2.4***
Johannesburg	***44***	***2.0***
eThekwini	***32***	***1.3***
Nelson Mandela	***12***	***1.5***
Buffalo City	***16***	***2.8***

2.5.2 Epidemiology and outcome of firearm-related injuries in children

In general, the literature revealed that the demography of children with gun-related injuries did not vary significantly. Eber et al. [63] found in their national survey that firearm-related injuries and fatalities happened more often among boys (between 10 and 14 years of age)

within the Black population group. Similar observations have been documented in the study conducted by Singer et al. [64]

On the one hand, according to Eber et al., [63] 43% of the non-fatal injuries were sustained intentionally (assault), and a similar percentage was unintentional (accidental). This is distinct from the circumstances associated with fatalities, where the majority (76%) were killed intentionally. On the other hand, Singer et al. [64] found that the majority of injuries (71%) happened unintentionally, while 28% were sustained intentionally. The circumstances of injuries in children varied according to their age and race. Most white and younger children in the study were shot unintentionally, while in the case of black and older children the shootings were intentional. [64]

The time and place of occurrence of firearm injuries were found to be different according to the circumstance of shooting. Unintentional injuries were more frequent in the afternoons between 4 pm and 5 pm, and principally took place at home. This might be attributed to the fact that parents at this time are still not home, and therefore, children were not supervised. Intentional (assaultive) firearm-related injuries were more frequent in the late evening between 8 pm and 9 pm and took place in the road and other public places. These findings were linked to both criminal activities relating to drugs and substance abuse as well as gang violence. [66]

With regard to injury patterns and outcomes, Eber et al. found that the lower extremities of the body were the most common injury sites, followed by the head, trunk and upper extremity in equal proportions. [63] According to Li et al. [66] and Singer *et al* [64], a large proportion of firearm-related injuries in children involved the head.

Singer stated [64] that about 17% of the injured children required surgery. The author added that the hospital stay was equal or less than one day in more than half of children (57%), less or equal a week in quarter of children 25%, and the rest were admitted for longer than a week. The median length of hospital stay was one day. (Range, 0-71 days). The overall mortality rate was 9.3%. Most deaths occurred in children under 4 years of age (20.0%) and those sustaining head injuries (23.7%).

In South Africa, there are only two studies relevant to descriptive epidemiology and outcomes for firearm-related injuries in children. One of these is from Cape Town [25]; the other is from Durban. [28] Both studies focus on children up to the age of 12 years for a timespan of approximately ten years. They report demographic data and data on circumstances of injury, duration of hospital stay, management as well as mortality and long-term morbidity.

In the Cape Town study [25], which reviewed data from 1991–2001, 270 victims have been identified. The most common injury sites were found to be the lower extremities (52%) followed by the head (20%). Out of the 52 shooting incidents involving the head, 23 caused facial injuries and 29 caused head injuries. Of these, 18 involved intracranial structures, seven were skull fractures and four were soft tissue injuries. It is noteworthy that the site of the bullet's entry into the body was not always the same as the site of the injury. For example, a bullet wound to the chest could cause intra-abdominal injury.

More than half (54%) of the injuries required surgical intervention. The injuries in general took 1, 063 hospital days, of which 29% were related to abdominal injuries; 26% were injuries involving lower extremities; and, 22% including the head. The study found also that shootings resulting in head injuries accounted for 60% of ICU admissions. Complications were detected in 16 cases (7%), while the mortality rate was 6%.

In the Durban study [28] (which is more for historical interest, as it reviews presentations from 1983 to 1995), 106 victims were identified. This study was set in paediatrics general surgical ward. And perhaps that is why the authors found intra-abdominal injuries to occur most often (47%), followed by injuries to the lower extremities (28%). Moreover, the authors found a direct correlation between mortality and the number of abdominal organs injured. The increased risk of a head injury and intra-abdominal injury in children was thought to be attributed to their poorly safe-guarded abdominal contents as well as their relatively large heads. Also, a larger proportion of injuries (63%) required emergency operation and 29% of children were admitted to the ICU. The in-hospital mortality rate was 10.4%, while major morbidities such as hemiplegia, paraplegia, major peripheral nerve defects, and, amputations were recorded in 11, 4% of children.

In general, the two studies [25, 28] found firearm-related injuries occur more often in males and, that it increases with age. They both agreed also that Shooting was typically unintentional as most of the time the children were innocent bystanders caught in the crossfire.

2.6 Conclusion

The history of South Africa is marred by violent experiences. Firearms were entrenched in the country's political culture leaving a long-lasting stain that continues to associate South Africa with violence. Besides the availability and easy accessibility of firearms, the issue of violence is a product of a complex set of factors related to culture, community, and socioeconomics. The geographical distribution of violence across the country reflects the disparity in these factors as there are "hot "and "cold" zones of violence between and within the major urban cities.

The South African Firearms Control Act was enacted in 2000 and came into force in 2004 to ensure that firearm acquisition processes and procedures were strictly controlled in order to reduce firearm-related violence. Beyond the immediate impact of injuries and deaths, violence involving the use of firearms, has direct and indirect social and economic negative impacts that affects both the individuals involved and the government.

Children and adolescents are not excluded from firearm-related violence, and the circumstances under which children sustain injuries are diverse. These injuries and fatalities are not always a result of violence as some are unintentional. However, violence is described as a common central subject in the majority of existing literature related to firearm-related injuries and fatalities.

3 Methodology

3.1 Research Question

The study was undertaken to answer two questions:

i. What is the clinical epidemiology of firearm-related injuries and mortalities among children in the Cape Town Metropole between 2001 and 2011?

ii. Has the Firearms Control Act No. 60 of 2000, and the related Bills and regulations, reduced the rate of gun-related injuries and deaths among children in Cape Town?

3.2 Aim

There were two aims for this study:

i. To describe the clinical epidemiological data of firearm-related injuries and mortalities among children presented to the main public hospitals in Cape Town

ii. To assess the efficacy of the Firearms Control Act on the incidence rate of gun-related injuries and deaths among children in Cape Town.

3.3 Objectives

The following objectives frame these aims:

1. To determine the demographic details of children injured or killed by firearms
2. To determine the places of occurrence of these injuries and the circumstances of injury
3. To chart the most frequently affected anatomical sites of children who have been hurt or killed by guns
4. To detect the patterns of injuries related to firearms in children

5. To assess the severity of these injuries
6. To document the types of initial treatment provided, including any surgical interventions
7. To ascertain the disposition of patients from the trauma unit (that is, whether they have been discharged or admitted to another ward/ICU).
8. To determine the morbidity (that is, complications, length of hospital and ICU stay).
9. To determine the incidence of firearm-related injuries
10. To determine the child mortality rates due to firearms

3.4 Study design

This study was a retrospective review of hospital and mortuary records over an 11-year period: from 1 January 2001 to 31 December 2011.

3.5 Study setting

This study took place in Cape Town, one of South Africa's five metropolitan municipalities. Cape Town is situated on the southern peninsula of the Western Cape Province. The Metropole extends over a geographical area of 2,479 km2. The population of Cape Town was an estimated 3,367,235 people in 2007, which accounts for 65% of the Western Cape population. [66]

The study focuses on two paediatric trauma hospitals in Cape Town: Red Cross War Memorial Children's Hospital (RXH) and Tygerberg Hospital (TBH). Together, these two hospitals represent the only state-run paediatric units that see paediatric trauma. They, therefore, cover the majority of major paediatric injuries in the Cape Town Metropole. Patients seeking private healthcare are excluded from this study. The mortuary data was taken

from the two state mortuaries in the city: Salt River Mortuary and Tygerberg Mortuary. A brief description of these sites is presented in the following paragraphs.

3.5.1 Red Cross War Memorial Children's Hospital

Red Cross War Memorial Children's Hospital (RXH) was inaugurated in 1956 as a dedicated and highly specialized children's health care facility. It currently remains the only children's hospital in southern Africa serving as a national (and international) referral centre. It has 290 beds for inpatients and 73 outpatient clinics with a staff complement of 1, 100. [68] RXH contains the only independent level-one paediatric trauma unit in South Africa with a large local service area that includes Table Bay, the Cape Flats and the Southern Suburbs. In addition, RXH provides tertiary level services to all hospitals in the Western Cape region, managing approximately 10,000 children annually. [25]

3.5.2 Tygerberg Hospital

Tygerberg Hospital (TBH) is an academic tertiary level hospital that was launched in 1976. There are more than 4,000 staff members at TBH including nurses, doctors, and support staff. The hospital has an annual admission of 90,000 inpatients and 500,000 outpatient visits. It is the largest hospital in the Western Cape and the second largest hospital in South Africa. [69] TBH serves as a teaching hospital for the Faculty of Medicine and Health Sciences at the University of Stellenbosch, the University of the Western Cape and the Cape Peninsula University of Technology. [69]

3.5.3 Salt River and Tygerberg Mortuaries

The Divisions of Forensic Medicine at the University of Cape Town (UCT) and the Stellenbosch University (SUN) are based at the Salt River and Tygerberg mortuaries, respectively. These two mortuaries are the two state mortuaries in Cape Town. The divisions at both universities provide Forensic Pathology Services and are accountable for the medico-

legal investigations of all unnatural or suspicious deaths in Cape Town. The results of this survey will therefore accurately reflect the total number of paediatric deaths in the Cape Town Metropole. Each mortuary performs around 3,000 autopsies every year. [70, 71]

3.6 Study population:

All paediatric patients who presented at the aforementioned hospitals and mortuaries for the 11-year period were eligible for the study.

3.6.1 Subject selection

3.6.1.1 ***Inclusion criteria:***

1. Children under the age of 13 years (the cut-off age for treatment at children's hospitals in Cape Town is 12 years)
2. Recorded cases of children admitted with firearm-related injuries, and,
3. Recorded cases of children who died from firearm-related injuries.

3.6.1.2 ***Exclusion criteria:***

1. Cases in which folders were missing. Where a folder was not available at the time of request, a waiting period of five working days was accorded to attempt retrieval before declaring the file missing.
2. Cases with incomplete or unclear entries in the database.

3.7 Data collection and management

3.7.1 Injuries

The Child Accident Prevention Foundation of Southern Africa (CAPFSA) was established in 1987 with the aim of preventing injury and death among South African children. At RXH, the

hospital data was retrieved from the CAPFSA database. It contains data on childhood injuries and deaths presented at the RXH trauma unit, which has been gathered continuously since 1991. This database serves as a surveillance system of childhood injuries and is considered to be one of the leading paediatric injury databases in South Africa. [72] At the trauma unit, patients' data are captured on standardized forms with specific serial numbers and then registered in a specific registry book. These forms are collected by CAPFSA according to the serial numbers in the registry book before being entered into the database. Missing forms are retrieved from the medical record by means of the serial and folder number. According to CPFSA (personal communication with Abrahams Y, 2012 June 24,), this retrieval process is successful in 97% of cases.

At TBH, the data on injured children was obtained from the Medical Records Department with the aid of the Statistical Department of the hospital. Cases which fit the inclusion criteria were identified from the CAPFSA database at RXH and from data provided by the Statistics Department at TBH using the following injury codes: firearm, gunshot, homicide, or assault. Hospital folders for eligible cases were requested from the medical records departments at both hospitals.

A standardized collection form [appendix 1] was used to record the data. This form was adapted from the RXH trauma sheet [appendix 2]. The data were retrieved and recorded by the Principal Investigator.

The collected data included the following variables:

1. The year of injury
2. The demographic details of the child including the age and gender. To determine if the injuries predominated in one group, the age was further categorised into two groups: younger children (0-5 years) and older children (6-12 year).

3. The place of occurrence of the injury. These places were categorised into the following:

    - Inside home.
    - Outside home (i.e., area right in the front or back of the residence such as the yard or garden),
    - Road or pavement (these two places are recorded as a single variable in both hospitals).
    - Public spaces (for example, shops, schools, crèche).
    - Unknown.

4. The circumstance of injury. The intention behind injuries classified as intentional (that is, assaultive) and non-intentional (for example, where the child was caught in crossfire or where the firearm went off accidentally such as while playing or cleaning).

5. The number of shots sustained by the patient: single or multiple.

6. The anatomical site of the injury which was categorised into the following:

    - The head region (that is, the head and face)
    - The chest
    - The upper limbs
    - The abdomen
    - The lower limbs
    - Others, which include the neck, the back, genitalia, buttocks

7. The injury pattern or pathology involved the following:

- Superficial laceration
- Complicated laceration
- Neurovascular injury
- Fracture
- Haemopneumothorax (Pneumothorax or haemothoax)
- Foreign body (bullet)

  The superficial lacerations involve abrasions and superficial wound sites that only require a simple suture or dressing. Complicated lacerations are deeper wounds and may be associated with internal organ damage and, therefore, require more sophisticated surgical interventions in most instances.

8. The Severity of the injury: Here, injuries were ranked on a scale of 1 to 4:

    1. Minor
    2. Moderate
    3. Severe
    4. Mortal

9. Treatment provided at the trauma unit, including any surgical procedures required:

    - Advice/Analgesia/Antibiotics
    - Dressing or Plaster of Paris (POP)
    - Observation
    - Suture
    - Open operation (at the operation theatre of the trauma centre)
    - Removal of the bullet (under local aesthesia.)

10. Morbidity (including complications and length of stay at the hospital's wards or ICU),

11. In-hospital mortality.

12. Discharge from Trauma Unit (discharge, admission to ward, ICU admission).

After recording the data on the collection forms, it was transcribed onto a spread sheets.

3.7.2 Deaths

Mortality information was obtained from the databases and forensic reports available at the Divisions of Forensic Medicine at UCT and SUN. The mortuary data are captured in a computerized database at both divisions. The data includes demographic information such as age, sex, and race; and, clinical information such as place of occurrence and the findings of the physical examination.

Cases from 1 January 2001 to 31 December 2011 which led to deaths and fit the inclusion criteria were retrieved from the database of the Division of Forensic Medicine at UCT and SUN. It should be noted that forensic records has been improved significantly after the transfer of forensic services from SAPS to the department of health in 2006.

Data on children who died at the hospitals was cross-checked with the mortuary data in order to avoid duplicate entries. Hospital numbers and dates of birth were also used in the cross-checking process.

The data of interest included:

1. Year of death
2. Age
3. Gender
4. Anatomical site of the injury

All forensic records were first captured on data collection forms [appendix 3] and then transcribed onto a spreadsheet.

3.8 The comparison of firearm injury and death rates before and after the Firearms Control Act

The injury and death rates that occurred during the four years before the Firearms Control Act of 2004 was compared with the four years after to assess the effect of this Act on the incidence of injuries and deaths to children due to firearms. The time period of this comparative part is from 1 January 2001 to 31 December 2004 and, from 1 January 2008 to 31 December 2011. The time gap between 1 January 2005 and 31 December 2007 was considered a transitional period and therefore excluded.

Population (census) data was accessed from Statistics South Africa (STATS SA) to calculate the incidence rates of injuries and deaths during the study period. According to the 2001 census [73], the number of children below 13 years of age in Cape Town was 668,781 in 2001 (the starting point of the study). This constitutes almost 24% of the city's total population (2,801,791). The annual mid-year population estimates lack specific data for children under the age of 13 in Cape Town. Instead, the annual change in number was estimated according to the annual population growth rate in South Africa from the years 2001 to 2011 that was released by STATS SA in 2011.[74] See Table 3.

This data provided the closest estimation available of the incidence rate of injuries and deaths in children per year during the study period.

Table 4 Population estimated of children < 13 year old in Cape Town (2001-2011)

Period	*Rate %*	*Population estimate*
2001–2002	*1,33*	*668 781*
2002–2003	*1,30*	*677 676*
2003–2004	*1,28*	*686 486*
2004–2005	*1,25*	*695 273*
2005–2006	*1,23*	*703 963*
2006–2007	*1,20*	*712 621*
2007–2008	*1,18*	*721 172*
2008–2009	*1,15*	*729 681*
2009–2010	*1,12*	*738 072*
2010-2011	*1,10*	*746 338*

3.9 Statistical analyses

The Statistical Sciences Department at the University of Cape Town assisted with statistical analysis. The data was analysed using STATISTICA® version 9 (Stat Soft Inc. (2009)) STATIST.

The first part of the study is descriptive. It is a record of the epidemiology of firearm-related injuries and deaths in children. This part was done using basic descriptive statistics. The distribution of variables was presented with histograms and frequency tables. Means or medians were used as measures of central location for ordinal and continuous variables, while quartiles or standard deviations were used as indicators of spread, depending on the distribution of the variables.

The second part of the study is the analytic. In this section, we compared the rate of injuries and fatalities in children before and after the implementation of the Firearms Control Act of 2004. To analyse this part, an analysis of variance (ANOVA) © (IBM Corporation 1989, 2011) was used to determine whether there were any significant differences in the mean injury and mortality rate in the two time periods, before and after the Act came into effect. A significance level of 5% was applied. In addition, mortality rates and injury rates were regressed across the years of interest to assess the trend.

3.10 Ethical and legal considerations

We ensured that all the ethical practices of both medical and academic research were met as required by the ethics committees of both the hospitals and mortuaries, and, the universities involved with this study. Patient anonymity was protected during the course of the study. Each patient was allocated an individual serial (study) number to ensure anonymity. Two sheets were used to record data. The coded sheet (which was used for analysis) included only the patients' serial numbers. The decoding sheet (which included the patient's hospital number and the serial number) was kept separate, accessible only to the Principal Investigator in a password protected electronic file.

The study was conducted in line with the Declaration of Helsinki, 6th Revision (2008) [75] and local research rules compiled by the MRC. [76] UCT's Faculty of Health Sciences Research Committee granted ethics clearance for the research to be conducted. (Appendix 4). Approval to conduct the study was obtained from the administrations of the selected hospitals and the Division of Forensic Medicine at the UCT and SUN. (Appendix 5, 6, 7,)

4 Results

4.1 Firearm related injuries

From January 2001 through December 2011, 243 children were identified with firearm-related injuries in Cape Town. By applying the exclusion and inclusion criteria detailed in the previous section, 54 cases were excluded. The flow chart in Figure 6 details the inclusion and exclusion number of injuries.

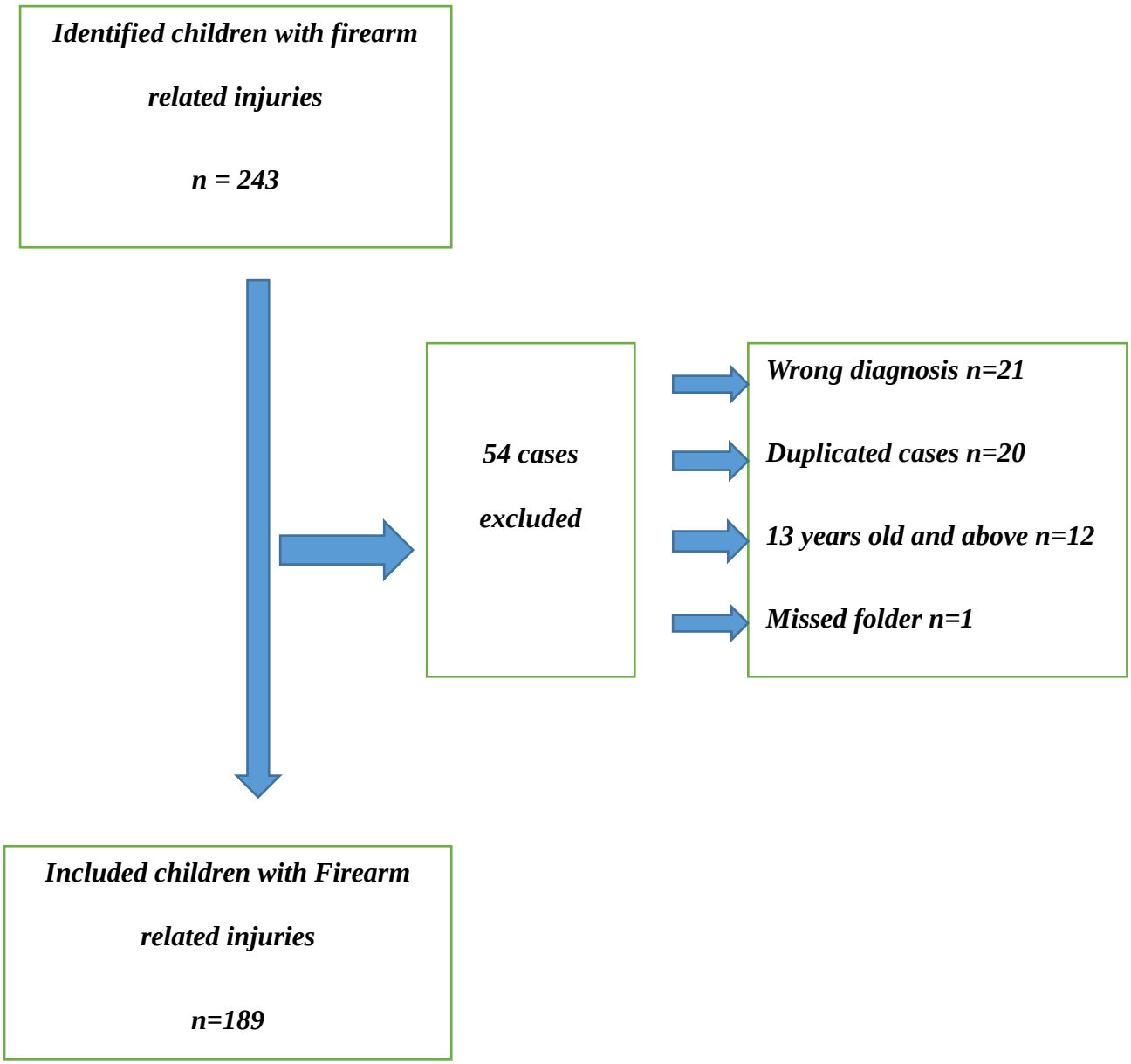

Figure 6 Flow chart for inclusion and exclusion of injuries in the study

The majority of injured children were seen at RXH. Table 5 shows the number of children who presented with firearm-related injuries at each hospital in the study.

Table 5 Number and percentages of children presented with firearm-related injuries per hospital during the study period.

Hospital	*Number of children*	*Percentage*
RXH	***175***	***92.5%***
TBH	***14***	***7.5%***
Total	***189***	***100%***

4.1.1 Demographic profile

Age

The median age of the subjects was eight. The minimum age was 6 months and the maximum age was 12. The inter quartile range (IQR) was between four and ten years of age. 127 of children (67.2%) were in the older age group (6–12 years) p <.001

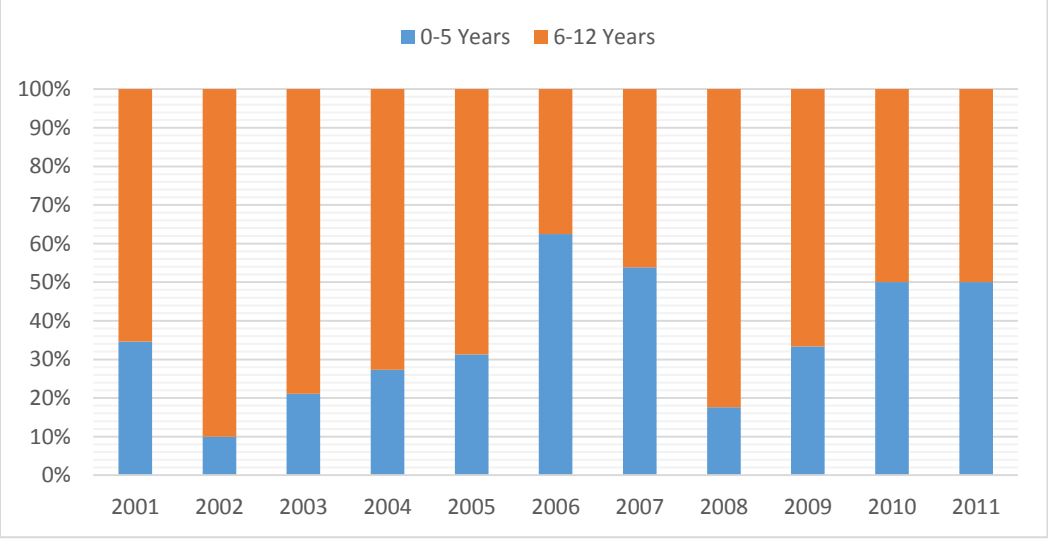

Figure 7 Percentage distribution of age groups by year (2001-2011).

Gender:

Firearm-related injuries occurred more frequently in males (62.43%) $p<0.01$. In almost all of the years considered, the percentage of males was higher compared to females except for the year 2010 where there was an equal split between the genders. See Table 6.

Table 6 Distribution of firearm-related injuries across year and gender.

	Male		**Female**		**Total**	
Year	***Frequency***	***% within the year***	***Frequency***	***% within the year***	***Frequency***	***% of total***
2001	***19***	***73***	***7***	***27***	***26***	***14***
2002	***17***	***57***	***13***	***43***	***30***	***16***
2003	***11***	***58***	***8***	***42***	***19***	***10***
2004	***8***	***73***	***3***	***27***	***11***	***6***
2005	***11***	***69***	***5***	***31***	***16***	***8***
2006	***9***	***56***	***7***	***44***	***16***	***8***
2007	***8***	***62***	***5***	***38***	***13***	***7***
2008	***10***	***59***	***7***	***41***	***17***	***9***
2009	***10***	***67***	***5***	***33***	***15***	***8***
2010	***6***	***50***	***6***	***50***	***12***	***6***
2011	***9***	***64***	***5***	***36***	***14***	***7***
Total	***118***	***62***	***71***	***38***	***189***	***100***

4.1.2 Place of injury occurrence

The greatest number of firearm-related injuries occurred outside the homes of the injured children. These injuries numbered 60 cases (32%). Figure 8 illustrates the percentage of places of occurrence of firearm-related injuries.

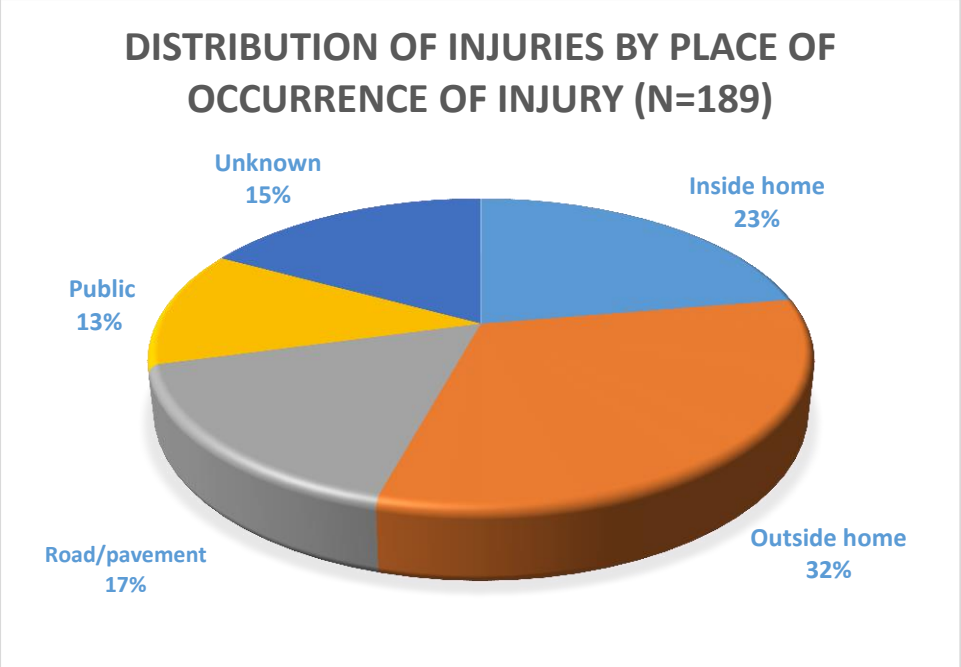

Figure 8 Distribution of firearm-related injuries according to place of occurrence.

4.1.3 Circumstances of injury

The circumstance surrounding a shooting incident was not documented in 75 cases which accounts for 40% of the total sample. Half of the total injuries (94 injuries) were reportedly unintentional whereas only 20 injuries (10%) were inflicted intentionally. For those unintentional injuries, the majority (73 cases) happened where the child was caught in cross-fire, while the rest (21 cases) were deemed accidental.

4.1.4 Number of shot(s) sustained by the patient

The number of shots sustained by the patient was documented in 139 cases. The majority of injuries 117 (84.17%) sustained only single shots, while multiple shots, as in the cases of assault and homicide, were found in 22 cases (15.83%).

4.1.5 Anatomical site of the injury

Information pertaining to the anatomical body parts that were injured by firearms was collected in all cases from the hospital database. Figure 9 shows the frequency of anatomical sites of gun-related injuries in children.

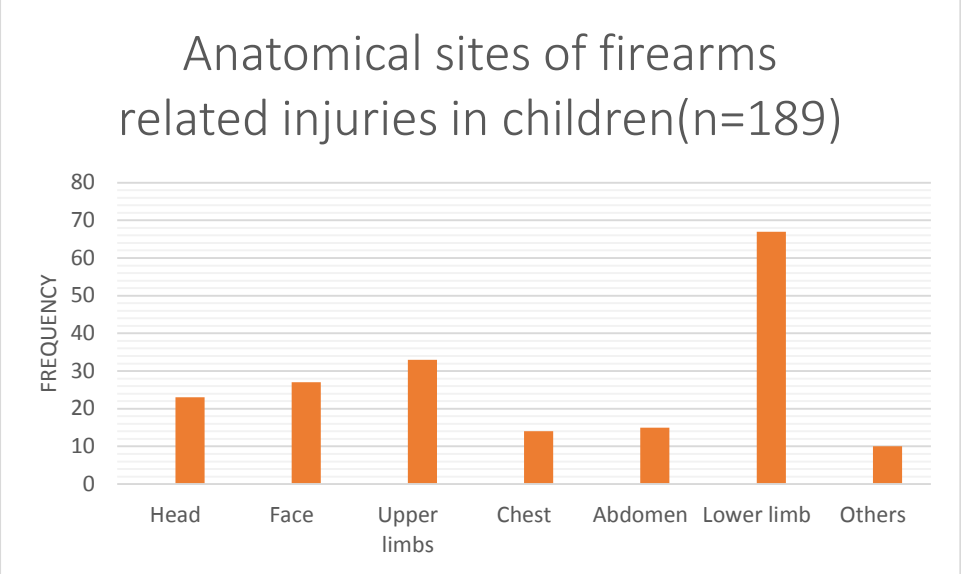

Figure 9 Distribution of anatomical sites of firearm-related injuries in children.

Most children (53%) were shot in their lower and upper limbs followed by the head region involving both the head and face (26%). Of the 27 injuries reported to the face, 16 (59%) were to the eye.

4.1.6 Pattern of injury/ pathology

In terms of injury pattern/pathology, a large number of children sustained both superficial and complicated lacerations (72 and 37 cases respectively). Figure 10 illustrates the frequency of patterns of firearm-related injuries.

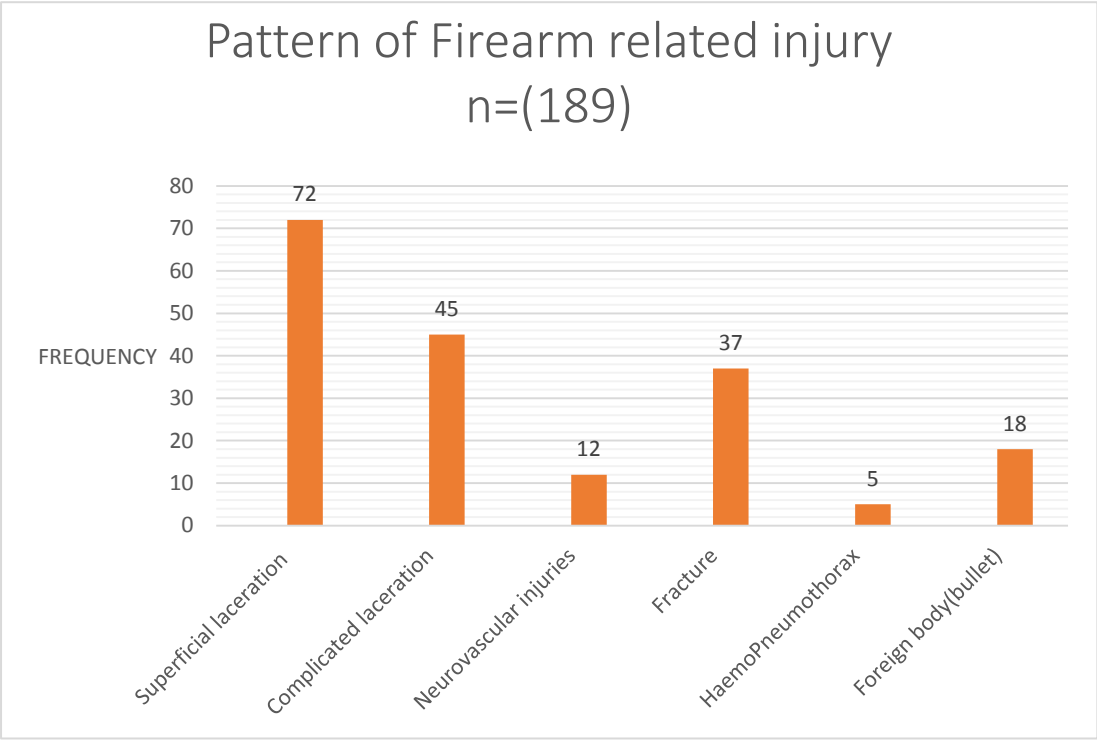

Figure 10 Number of firearm-related injuries according to the pattern of injury

4.1.7 Severity of the Injury

Nearly half of the injuries sustained (95 injuries) were moderate in severity, whereas 56 injuries (29.3%) were estimated to be mild. Only 33 cases (17.46%) were deemed severe and five injuries (2.65%) were fatal.

4.1.8 Treatment provided at trauma unit

Figure 11 details the percentage of treatment varieties provided at the trauma unit for injured children. 72 injuries (38%) were treated at the trauma unit with dressing or applying POP.

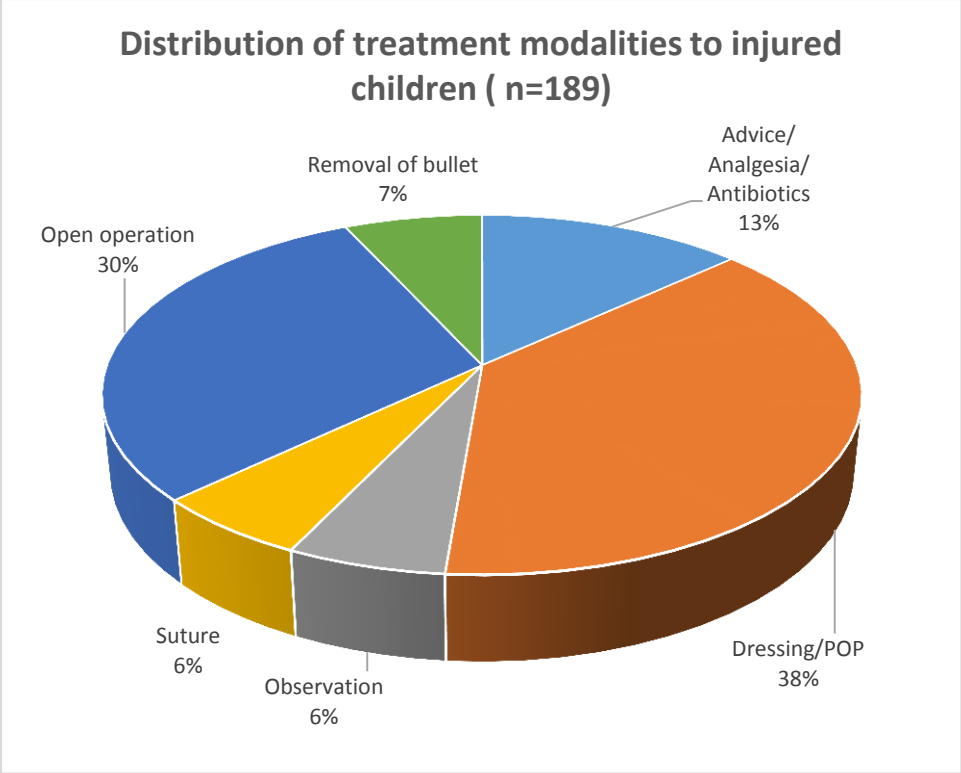

Figure 11 Treatment modalities provided at the trauma units.

Surgical interventions done in the trauma unit or at the time of admission were 37%. If one adds the surgical interventions done at a later stage of hospital stay, the number increases to 76 (40%). In general, the surgical interventions ranged from simple procedures such as wound debridement and removal of bullets—under local or general anaesthesia in the trauma unit—to more complex surgeries such as laparotomies and craniotomies in the main operation theatre. (See table 7)

Table 7 Surgical procedures performed for injuries.

Surgical procedure	***Number***
Wound debridement	***30***
Removal of bullets.	***15***
Examination Under Anaesthesia (EUA)	***5***
Open reduction internal fixation (ORIF)	***11***
Craniotomy	***7***
Laparotomy	***8***
Total	***76***

4.1.9 Morbidity

Apart from surgery, the morbidity (complications, hospital and ICU stays) data were available for 138 cases (73% of the study subjects).

From the available data, complications were observed in only 11(8%) children. Most of the complications involved infections (8 cases). There were two reported cases of paraplegia and one case of quadriplegia due to neck injury.

The median length of stay in hospitals for children after sustaining firearm injuries was two days with an IQR of 0-5 days. The maximum length of the stay was 50 days.

In general, firearm-related injuries took about 586 days of in-hospital stay during the study period. The majority of the in-hospital stays was attributed to head injuries which were accountable for 188 days (32% of the total length of hospital stay). Although abdominal injuries accounted for only 8% of the total injuries, they were accountable for 147 days (25% of the total length of hospital stay). ICU admissions were reported in 15 children who spent a total of 81 days (14% length of hospital stay). The majority of the cases of ICU admissions in children with firearm-related injuries were due to severe head injuries with intracranial damage (57%).

4.1.10 In-hospital mortality

Only five children (2.65%) died in the hospitals. Four died due to direct shooting to the head while the 5^{th} one sustained a fatal chest injury. All the deaths were reported from RXH.

4.1.11 Discharge from trauma unit

102 children (54% of total injuries) were admitted to hospital -with 68 of those cases (67%) sent to the trauma ward. The remaining 87 children (46%) were discharged home with

referrals to a general physician, day hospitals or outpatient clinics. Table 8 details the discharge destinations of injured children from the trauma units.

Table 8 Discharge destinations of injured children from trauma units.

Discharge	N	%	Cumulative
Home/GP	***55***	***29.1***	***29.1***
Day Hospital	***6***	***3.17***	***32.28***
Other Hospital	***1***	***0.53***	***32.8***
Outpatient	***26***	***13.76***	***46.56***
Trauma ward	***68***	***35.98***	***82.54***
Other ward	***7***	***3.70***	***86.24***
ICU	***13***	***6.88***	***93.12***
Theatre	***8***	***4.23***	***97.35***
Died	***5***	***2.65***	***100***
Total	***189***	***100***	

4.2 Firearm-related deaths

The actual included number of children with firearm related deaths was 65. Figure 12 illustrate the flowchart of inclusion and exclusion number of deaths.

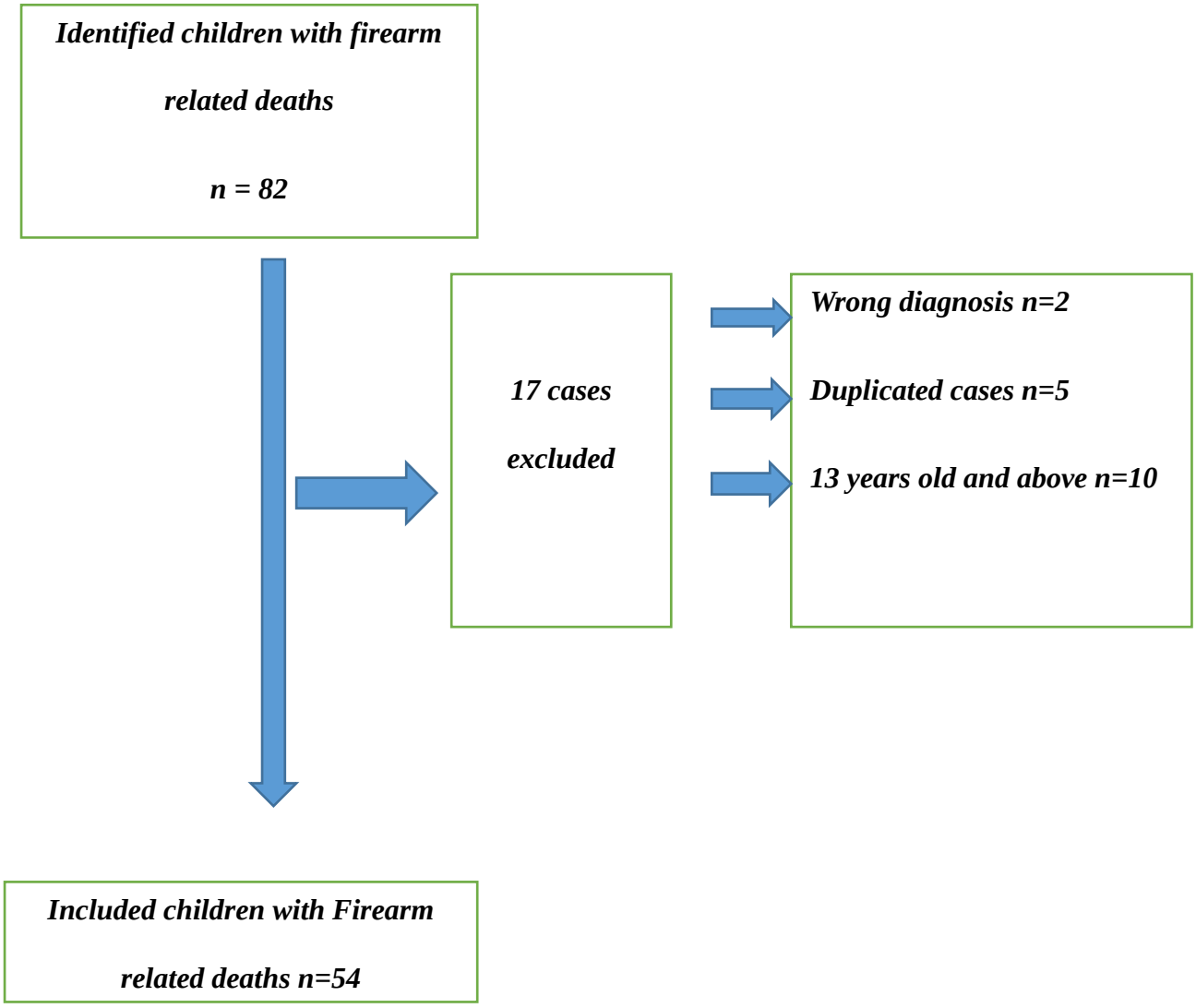

Figure 12. Flowchart of inclusion and exclusion of deaths in the study.

61.5% of the included cases were recorded at the Tygerberg mortuary. Table 9 shows the numbers and percentage of deaths in children collected from each of the involved mortuaries.

Table 9 Children with firearm-related deaths per mortuary.

Mortuary	Number of deaths	%
Salt river	***25***	***38.5%***
Tygerberg	***40***	***61.5%***
Total	***65***	***100%***

4.2.1 Demographic profile

Age:

Of the 65 children considered for this part of the study, the minimum age at death was six months and the maximum 12 years. The median age was six years. The inter-quartile range was found to be between three and nine years of age. A total of 31 cases (48%) were age 0-5 years, while the other 34 cases (52%) were age 6-12 years. The proportions for both age groups did not differ statistically (p=0.71).

Gender:

Of the 65 studied fatalities, 37 (57 %) were male and 28 (43%) were female (p=0.264)

4.2.2 Anatomical site of the injury

The distribution of site injuries for these mortality cases are summarized in Figure 13. It was noted that the majority of the cases (n=39, 60%) had head injuries. The number of chest injuries (n=13, 20%) was the second most common type.

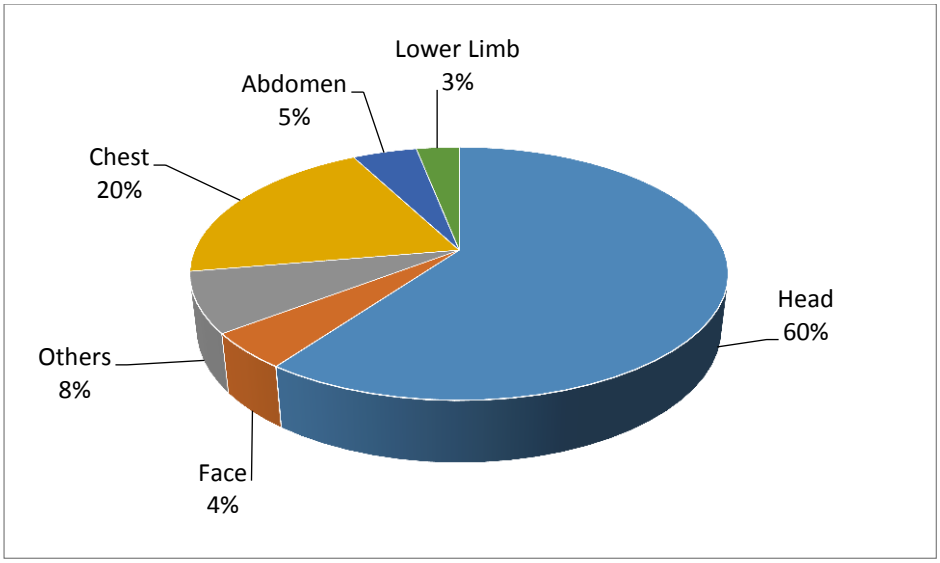

Figure 13. Distribution of deaths by anatomical site of injury (n=65)

4.3 Comparison of firearm-related injuries and deaths among children before and after the Firearm Control Act.

Table 10 details the number and the incidence of firearm injuries and deaths in children from Cape Town during 2001-2011.

The data indicate a peak of injury incidence in the year 2002. This is followed by a pattern of decline for the years 2003 and 2004. The trend from 2004 to 2011 seemed to have a relatively flat pattern.

In term of deaths, the highest record of mortality rate was in 2001, and the two lowest points were in 2010 and 2004. While the mortality data tended to fluctuate across the years, there is a visually downward trend.

Table 10 Frequency and rate of firearm injuries and deaths in children of Cape Town (2001-2011).

Year	*Number presenting at hospitals*	*Number seen at mortuaries*	*Firearm Injury incidence rate per 100,000*	*Firearm Mortality incidence rate per 100,000*
2001	*26*	*14*	*3.88*	*2.09*
2002	*30*	*8*	*4.42*	*1.18*
2003	*18*	*12*	*2.62*	*1.74*
2004	*12*	*1*	*1.72*	*0.14*
2005	*16*	*7*	*2.27*	*0.99*
2006	*16*	*7*	*2.24*	*0.98*
2007	*13*	*9*	*1.8*	*1.24*
2008	*17*	*3*	*2.32*	*0.41*
2009	*15*	*3*	*2.03*	*0.4*
2010	*12*	*0*	*1.6*	*0*
2011	*14*	*1*	*1.85*	*0.13*
Total	*189*	*65*		

To assess the impact of the Firearms Control Act of 2004, the injury and mortality rate was evaluated within the four years before (2001-2004) the Act, and within the four years after (2008-2011) the Act was promulgated. Time series analysis was not feasible due to the very small number of data points (the minimum recommended is at least 50 data points). Instead, an analysis of variance (ANOVA) was conducted to assess the mean differences (of injuries and deaths) between the years before (2001-2004) and years after (2008-2011) the implementation of the Firearms Control Act. Table 11 presents a summary of the ANOVA.

Table 11 Comparison of mean number of deaths and injuries.

Variable	*Period*	*N*	*Mean*	*Std. Error*	*F (2,8)*	*p value*
No. of Deaths	Before	4	8.75	2.87	4.09	.06
	After	4	1.75	.75		
No. of Injuries	Before	4	21.50	4.03	2.20	.173
	After	4	14.50	1.04		

The findings indicate that the mean numbers of deaths and injuries across the two periods (before and after the Act was enacted) do not statistically differ.

Mortality and injury rates were regressed across the years to assess the trend. Regression lines were accordingly fitted through the scatter plot of the data (See Figures 14 and 15). The injury rate per 100,000 was used in these analyses. The results indicated a downward linear trend in injury rates (b=-.2043) and mortality rates (b=-.1614) across the years of interest.

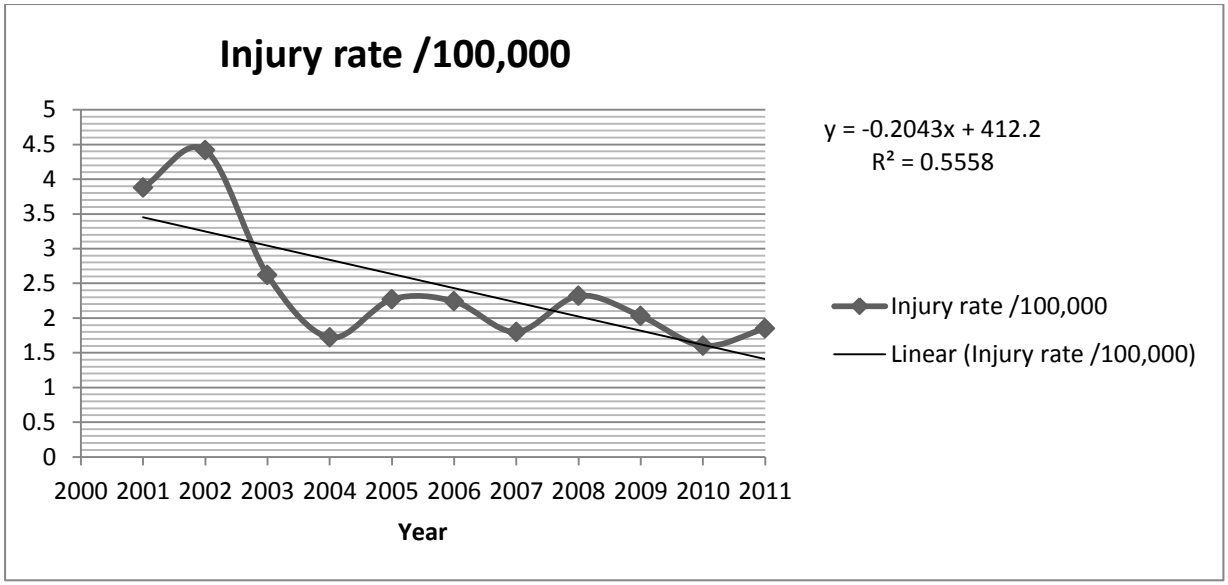

Figure 14. Linear model for injury rate.

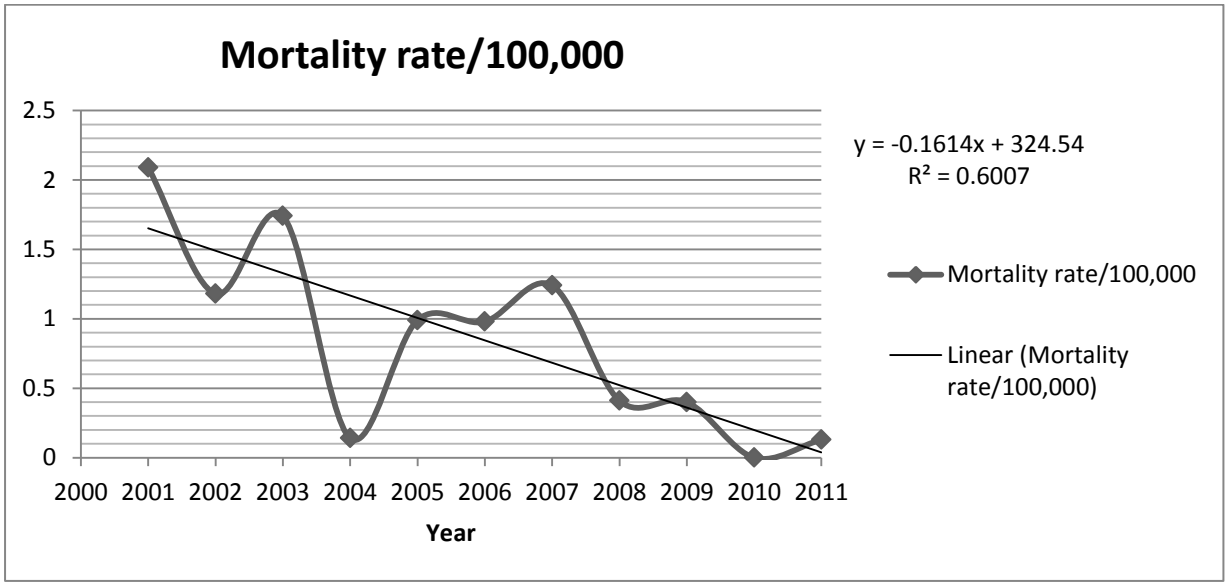

Figure 15. Linear model for mortality rate.

The analysis of mean differences in injuries and deaths before and after the Firearms Control Act indicates that the figures remained the same. It is noted, however, that the power of the analysis (ANOVA) to detect the difference was low due to the very small sample size that

was used. Considering this limitation, a regression analysis was employed to identify the direction of a linear trend in the very limited set of data points. This analysis displayed a declining pattern across the years considered in the analysis. Thus, the trend that was observable pre-2004 (before the law came into being) continued throughout the rest of the decade.

5 Discussion

5.1 Firearm-related injuries and deaths

5.1.1 Epidemiology

Demographics

The vast majority of children injured by firearms were treated at RXH. This is expected as it is the only hospital in Cape Town that has a specialised trauma centre dedicated for the treatment of children.

The demographic profile explored both the age and gender of the children injured or killed by firearms. Although all ages were affected, there was a trend that indicated more children from the older age group were injured than the younger group. In addition, a higher proportion of males suffered firearm-related injuries than females.

The male sex and older children have been described as high risk group in other studies from South Africa and the US. [25, 28, 64, 65] The model created by the WHO to understand the roots of violence also states that the innermost circle in which children mingle represents the personal and biological factors—including age and gender—that each individual will inculcate into their behaviour. [44, 77]

These findings are particularly important as they highlight a group of children that seem to be consistently vulnerable in incidents involving firearms.

It is well documented that males engage in more risky behaviour than females. This risky behaviour potentially exposes them to the injury. Firearm injuries in children are not exempt from this model. Lindsay and Miescher [78] clearly point out that Africa is an important region in which to study the social construction of gender since many scholars have proposed

that African gender identities are very contentious, deeply articulated with age, seniority, wealth, and ritual authority.

Place of occurrence of the injury

The results of this study indicate that there were specific potential environments where firearm-related injuries predominantly occurred. In contrast to the evidence from the United States that shows that the majority of injuries occur indoors, the evidence of South Africa demonstrates that the largest proportion of children (62%) were shot outdoors. They were shot either in close proximity to their homes, on roads and pavements, or in public areas. This dissimilarity could be attributed to the circumstances surrounding the shootings in both settings. This point will be discussed more in the next section.

Previous local studies supported our findings. [25, 28, 59] These studies added also that such incidents occurred mainly in townships or densely populated areas of the city where people experience social and economic hardship. [25, 28, 59]

As mentioned previously in the literature review, high levels of unemployment; a lack of proper facilities regarding housing; limited food; and, poor health, all lead to anxiety and frustration. These challenges contribute to the use violence. Economic disadvantage also plays a significant role in the likelihood of firearm-related injuries among children. Due to poverty, the children are more likely to walk to and from school or spend a large amount of time outside their homes, putting them more at risk of such injuries.

Circumstances of injury

The circumstances behind the shootings were not documented for a considerable number (40%) of cases, which complicates preventative efforts. It could be that the health care provider neglected to collect this information, yet it is acknowledged that acquiring a precise history, particularly from children, and determining the accurate circumstances of a shooting

is not an easy task. Additionally, parents have a propensity to keep away from medico-legal investigations. An analysis of police records would have provided better insight into the exact circumstances of the shootings.

In cases where the circumstance of the incident was recorded, the vast majority of children were injured unintentionally (being caught in cross-fire). The unintentional nature of incidents was supported also by the fact that the majority of children sustained a single shot injury.

Although the number of intentional assaults and homicides were fewer, the problem of violence cannot be ruled out because the majority of unintentional injuries occur during cross fire during gang fights.

As reported in the Introduction, the Cape Flats area of Cape Town (which is close to our study hospital RXH) has a long, established history and reputation for gang activity. Children (being young and vulnerable), become victims of stray bullets as they fail to run away and protect themselves. The majority of unintentional firearm injuries in children in Cape Town are undoubtedly tied up in gang violence.

The circumstances of unintentional firearm-related injuries in children in the United States are somewhat different. Studies suggest that the younger the child, the more likely it is that the injuries are unintentional in nature. [79] A high number of unintentional gun-related injuries occur while children are playing with unsecured guns or by an adult who is cleaning the gun. These dissimilar shooting circumstances mandate different preventive strategies. While preventive approaches in the US involve better education regarding locking and storing guns out of reach of children, preventive strategies in South Africa should address more the issue of violence and gang activities

5.1.2 Clinical patterns of injuries

Anatomical sites

The finding regarding anatomical sites of gun-related injuries indicates that the extremities were the most commonly injured parts of the victims' bodies. This finding could be due to the unintentional nature of shootings where children were frequently hit by a stray bullet. The distribution of injuries was similar to those found by the other study in Cape Town. [25] A slightly different finding was reported by the study in Durban, which found the abdomen to be the most commonly injured part of the body followed by the lower limbs. [28] This could be explained as that study only reviewed gunshot injuries admitted to the paediatric surgical ward.

Severity

The higher percentage of mild to moderate injuries may be explained by the fact that people in Cape Town largely use hand guns, which have slower projectiles and thus cause less fatal injuries. [32]

Patterns

The injury patterns were in keeping with findings from other studies. [25, 80] The majority of firearm injuries resulted in superficial lacerations that were treated with a dressing and simple suturing. Fractures were associated with 37% of lower and upper limb injuries. Haemo/pneumothoarces were the least common (2.6%) of the injury patterns as few children sustained injuries to the chest. This could be explained as shooting to the chest is usually fatal.

5.1.3 Outcomes

A significant number (40%) of injured children required surgical intervention. Unlike previous observations [25, 28], most surgical interventions involved injuries to the lower limbs, (n=28), 39%, and upper limbs, (n=13), 18%.

The average hospital stay was generally short. Injuries involving the head and abdomen generally required a longer stay. This is not surprising as injuries to these sites are more serious due to the vital organs located there.

Although it is less prevalent, injuries involving the head accounted for 54% of ICU admissions. Furthermore 40% of these head injuries ended up with complications.

Overall, the total hospital length of stay throughout the study period was reduced by nearly half (from 1,063 days to 586 days) in comparison to the previous 10-year survey conducted at RXH. [25] In addition, the complication rate of 5.8% was slightly less than reported in other studies. [25, 28] These findings can be explained by looking at the severity of the injury statistics. As opposed to the other studies [25, 28], most of the injuries reported during the survey period were mild to moderate injuries.

The data showed that the in-hospital mortality rate was related mostly to head trauma. Likewise, the mortuary data revealed that the most common injury site was the head area followed by the chest area. This is in keeping with national and international data. [28, 81]

5.2 Firearms Control Act

Death from firearm-related violence occurring in both adults and children remains one of the leading non-natural causes of death in Cape Town. The ease of firearm acquisition, the illegal pool of weapons, and the misuse of firearms and weapons, have put the lives of thousands of individuals at risk. The South African Firearms Control Act (FCA), which came into effect in

2004, was conceived to ensure that firearm acquisition processes and procedures were strictly controlled in order to reduce firearm-related crimes.

The Firearm Control Act (FCA) of South Africa has received mixed reviews from different sources regarding its effectiveness and efficiency. On the one hand, many of the interest groups, particularly firearm owners and manufacturers, have criticized the Act by stating that it fails to achieve the desired aims as it targets essentially the legal guns and not the illegal ones, which are used more in crimes and violence. In addition, there have been objections regarding the extensive amount of paperwork attached to the implementation of the Act. Many critics claim that the amount of paperwork prolongs the processing of firearm licensing and thus creates a huge backlog that, in turn, increases the risk of acquiring arms and weapons illegally. [39]

On the other hand, lobbyists that support the Act believe that reducing gun ownership will improve safety and security.

Our data -in keeping with national data, indicates a decline in the number of firearm-related injuries and deaths in children in the metropolitan area of Cape Town during the last decade. [38-41] However, the trend in injury and death rate observed prior to 2004 continued throughout the rest of the decade. This indicates that the law essentially had little effect in the overall trend of firearm injury and death rates.

This observation contrasts with another study by Abraham et al, on the impact of the FCA on gun-related female homicides. [82] The authors claimed that there was a significant decrease ($p=0.04$) in gun-related homicides across both intimate and non-intimate femicides in 2009 compared to 1999. This decrease is assumed by the authors to be related to the effect of recent firearm control legislation. [82]

However this finding should be read with caution as the authors only picked out two years for comparison as opposed to our study. Moreover, one must realize that firearm-related injuries in children are different from those in adults. In adults, gun-related injuries are usually related to interpersonal violence. The perpetrator usually intends to inflict injury, while children are often not the prime target; in most of the instances in our study, children were shot unintentionally. This means that the law might be more effective if we consider the injuries related to adult violence.

In evaluating our finding, it is essential to consider also other temporal factors and socioeconomic dynamics that took place during the last decade in the country. These include the declining trend in the overall crime rates in the country as shown by SAPS statistics, the level poverty, and the unemployment rates.

Although the GDP per capita does not reflect an individual's income, it is often viewed as an indicator of the standard of living for an individual in the country.[83] According to the data from the World Bank [84], there was a gradual increase in the GPD per capita in South Africa during the last decade (see Figure 16). It increased from US$ 3,000 in 2000 to US$ 3,835 in year 2011.

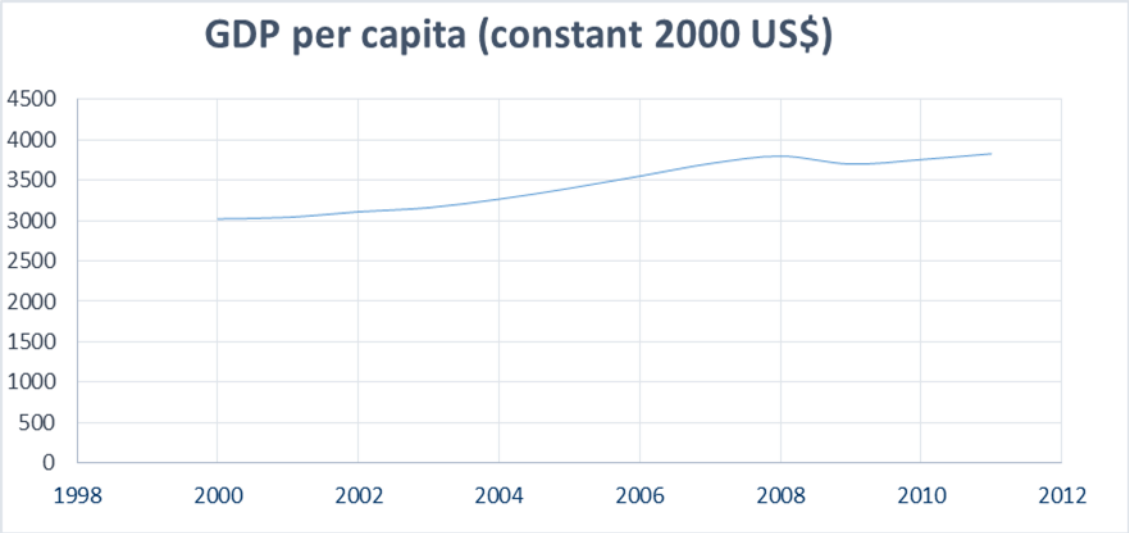

Figure 16 Graph illustrate the gradual increase in GDP per capita in South Africa (2000-2011)

Also, an analysis of the unemployment rates during the last decade (see Figure 17) showed that unemployment peaked at 31% in 2002 and 2003 before it declined gradually until 2008 after which it rose again. [84] The unemployment rate was last recorded at 24.9% of the total labour force in the second quarter of 2012. [12]

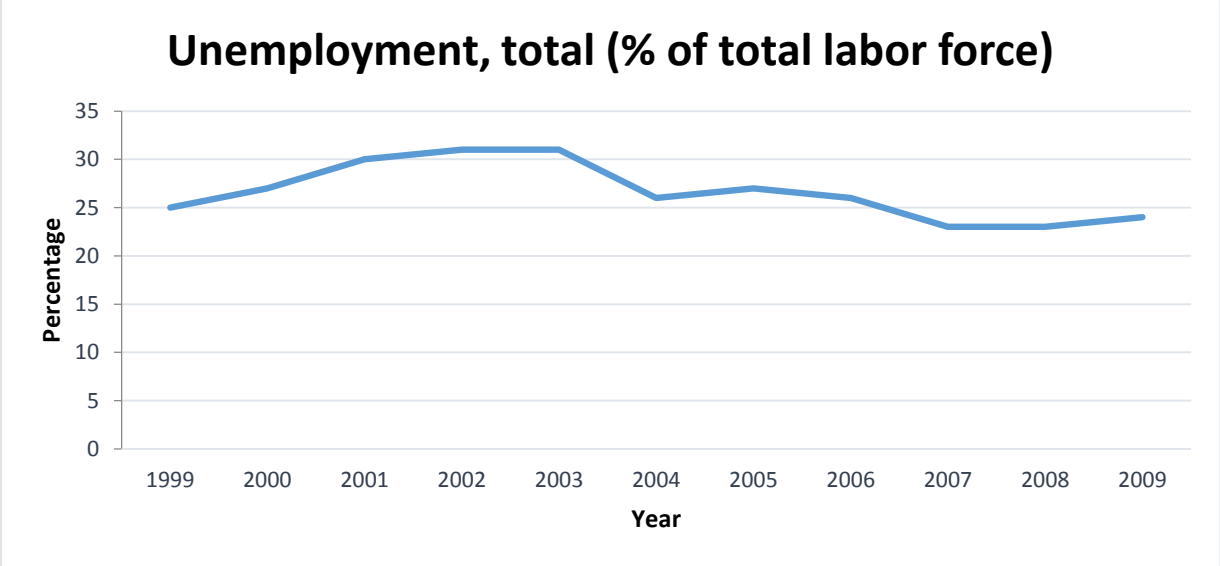

Figure 17 Unemployment rate by year from total labour force in South Africa (1999-2009)

These factors might have an impact on the overall trend in firearm-related homicides and injuries. Furthermore, they may explain why the trend in injuries and deaths caused by firearms did not change before and after the Act.

The improvement in these factors supposedly should reduce the trend of firearm injury and death after the Act. But this was not the case as demonstrated by our findings.

It is evident that countries with relaxed attitudes towards gun-control have a higher number of paediatric injuries and deaths. [85-87] However, the situation is South Africa including, Cape Town, is more complex. The issue of firearm violence in Cape Town is a product of multi-faceted socioeconomic determinants besides the abundance and availability of illegal firearms. Unless theses determinants are seriously addressed, it is very difficult for a single law against firearm to be effective in preventing deaths and injuries in children.

6 Limitations

Several limitations must be considered in relation to this study. Firstly, this was a medical database and records review, and the basic information available may be subject to human error. Because obtaining, interpreting, and recording data from histories, physical examinations, and ancillary tests, depends on the clinician, data of this kind are not always accurate. [88] However, this limitation was deemed minimal as the trauma units at both hospitals use a standard trauma sheets with pre-defined coded variables. [Appendix 2, 8] In the same manner, the obtained mortuary data were recorded by forensic pathologists on a standard sheet. [Appendix 9]

Secondly, any chart review is susceptible to data extraction errors, which can affect the study's validity. However, this type of error was minimized using a single trained data collector. [88] In addition, the data was entered separately into two datasheets, and then these were compared for discrepancies.

Thirdly, the database lacked sufficient details about the perpetrator-victim relationship and the types of firearms used. This limitation prevented us from assessing the sources of firearms (legal versus illegal) which may help with the prevention planning measures.

Fourthly, the study only reviewed data from the two paediatric tertiary hospitals in Cape Town. It is assumed that the vast majority of injured children in the city were included in the study. It is acknowledged that some cases may have been missed, particularly if the victims attended other district, regional, or private hospitals and were not referred to the study hospitals. These cases might possibly impact on the injuries, but not the recorded deaths, as the study reviewed data from the two state mortuaries in Cape Town.

Finally, a possible limitation relates to the generalizability of our study. Many other countries, including the United States, other African countries, and Latin American countries,

are also battling the issue of firearm-related deaths amongst children. Due to the variations in the political and socio-economic settings between countries, it would not be prudent to directly compare the situation of Cape Town with other dissimilar settings.

7 Recommendations

7.1 Recommendations for government and policy makers

While the government should put forth more effective measures to ensure the proper implementation of the law, it should give more emphasis to violence prevention by addressing the deep social roots of the problem.

Amongst others, the government should formulate long-term policy measures to change the attitude and behaviour of the population. Campaigns should be set up to educate the public, principally in the city's most violent zones, about the ill effects and consequences of violence and firearms, and, how to decrease gang and interpersonal violence.

Since a considerable number of children have also been injured accidentally, preventive strategies should include educational programs about the responsible handling of firearms. This includes safely storing firearms out of reach of children, using safety devices such as trigger locks or firearm safes, unloading the firearms when not in use, and other measures to reduce children's access to guns.

7.2 Recommendations for information/surveillance system

Emergency services at South African hospitals are being negatively affected by their inability to efficiently capture data about injuries caused by firearms. This prevents the health care services, other government departments and social organizations, from establishing effective violence control and injury prevention programs. Additionally, the lack of reliable health statistics has made it difficult to assess the impact of firearm-related injuries on the society, or even compare the setting of South Africa with that of other nations.

There is an imperative need for an enhanced reporting system for both injuries and deaths in the emergency centres in partnership with forensic pathologists and the SAPS. Communication links between the courts, police, social work centres, etc. should be maintained so that information is easily exchanged, collected and stored. This information gathering should include detailed information about the victim-perpetrator relationship, the circumstances of each incident, and the type and potential source of the firearm used. This information would assist in better understanding the nature and the root of the issue, which would be valuable in steering the preventative plan and targeting the resources to the areas with the maximum need. Local and national statistics are equally vital. While local data allow for assessment of particular regional programs, the national data give us an insight into the national trends and determines the priorities nationwide.

Furthermore, the information gained from the surveillance system about firearm-related violence should be made transparent and kept up to date. Statistics should be made available to the public so they can be more aware of the dangers of violence involving firearms. Such information will allow for both a more knowledgeable community debate and better community policy.

7.3 Recommendations for health care systems

Under-reporting of crimes is recognised as a major issue in South Africa. This challenge hinders gunshot monitoring and thus obstructs any preventive effort.

The health care system should make it mandatory for health care providers to report each and every incident that presents with of firearm-related injury to the SAPS. This procedure is currently common in several European countries. In South Africa however, it is argued that this application could possess a challenging safety issue for victims and perhaps discourage

them to seek medical help if they still feel threatened, as the perpetrator would know that the case would have been reported. Therefore, as an alternative, reporting could be performed without disclosing the identity of patients.

The healthcare system - in co-operation with other bodies - should also implement a strategy to gather necessary data related to firearms and related injuries that aid in lobbying the government to draft laws for the elimination of firearms and firearm-related injuries.

The hospitals and health care professionals should contribute more efficiently in educational programs addressing parents and the community. These programs should focus on public awareness of the danger of guns and prevention of violence and injury.

7.4 Recommendations for future research:

The health and safety of children are essential issues for any country. Regrettably, there is a dearth of data regarding firearm-related injuries and deaths in children in South Africa. The only available information is from review studies which potentially offer lacking and biased evidence. Therefore, prospective research is urgently needed in the area of firearm-related injuries in children.

Future researchers should give more emphasis to understanding the multi-dimensional determinants of violence towards children. An area of specific attention is firearm violence against boys. Furthermore, researchers should also focus on understanding the effectiveness of the government interventions to reduce the risk of exposure of children to firearm-related injuries. Using better techniques to collect data, researchers can also easily integrate the new data of firearm-related injuries among children to the long term impact and consequences on their personality through cross-sectional and longitudinal studies. Lastly, future studies

should be comprehensive and conducted in all provinces to offer a broader knowledge of the firearm-related injuries and deaths against children.

8 Conclusion

Health and safety are essential for the population of any country. The South African constitution clearly states that "*everyone has the right to freedom and security, and the right to be free from all forms of violence*". [89] When a child is harmed in his or her community, these rights are violated. Children, being young and sensitive, are more prone to injury and fatalities in violent countries like South Africa. These injuries and fatalities have short- and long-term implications for the health care system and the economy.

This study offers estimations of the incidence and epidemiological characteristics of fatal and non-fatal firearm-related injuries among children in Cape Town between 2001 and 2011. The key findings of this study indicate that the burden of firearm injuries falls disproportionately on boys and children aged 6 to 12 years old. In term of firearm fatalities, the impact was almost equally distributed among both age and gender groups. Injuries to children caused by firearms occur more frequently outside the victim's house. The injuries are usually unintentional in nature by stray bullet during gang fire. Non-fatal firearm-related injuries typically affect extremities, particularly lower limbs. Fatal injuries are usually ones involving the head.

Although the number of injuries and deaths related to firearms decreased drastically during the last eleven years, the injury and death rate that was observable prior to 2004—before the implementation of the FCA—continued throughout the rest of the decade indicating that the law in essence had little or no effect on the rates of firearm injuries and deaths.

Due to the unique political and socioeconomic situation in South Africa, the finding of this study might not be directly applicable to other settings. The prevention of gun-related injuries and deaths in children requires a multi-dimensional approach. Beside reduction the gun accessibility, there should be serious measures that address the socio-economic challenges

which contribute to gun violence. Application of both approaches will certainly make a generous impact on preventing firearm-related injuries and fatalities among children in the future.

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Appendix 1 - Hospital data Collection Form

Code No		***Year Of Injury***		***Age***		***Sex***	***M***	***F***

Place of occurrence:	*own home inside* ***1***	*own home outside****2***	*other home inside place****3***	*other home outside4*	*school/crèche****5***
	*Road/pavement****6***	*Public* ***7***	*Sport****8***	*Unknown* ***9***	*Others:****10***

Intentional:	*Yes****1***	*No****2***	*Non specified* ***3***

No of shot(s)	

AIS *(Abbreviated Injury Scale)*	***Mild****1*	***Moderate****2*	***Severe****3*	***Mortal****4*

Site of injury:	***Single****1*		***Multiple****2*	
*Head****1***	*Face****2***	*Neck****3***	*Chest****4***	*Upper limb****5***
*Abdomen****6***	*Lower limb****7***	*Back****8***	*Genitalia****9***	*Buttock****10***

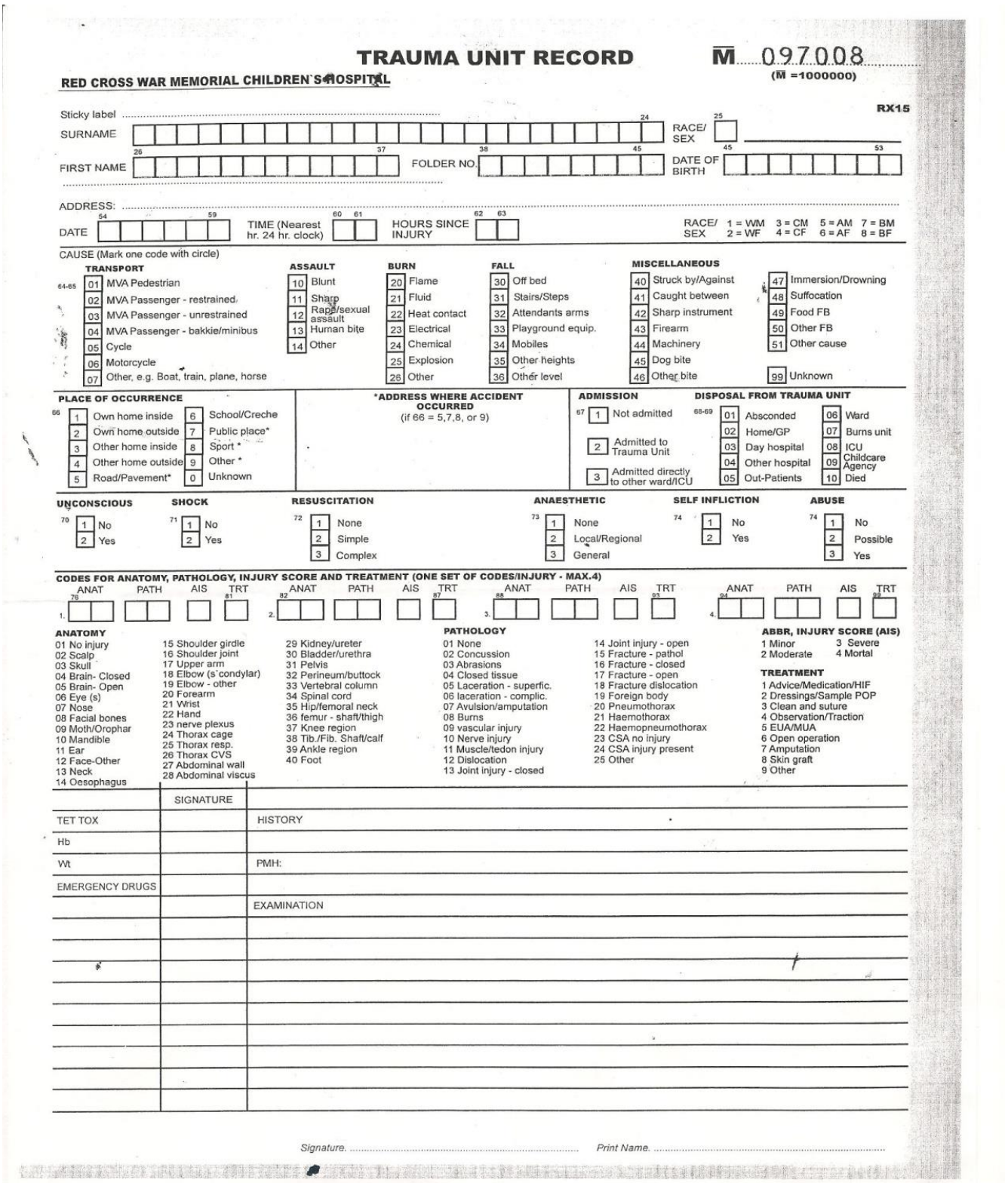
Injury patterns				
*Abrasion****1***	*Laceration/superficial****2***	*Laceration/ complicated****3***	*Vascular injury****4***	*Nerve injury****5***
*Muscle/tendon****6***	*Fracture****7***	*Pneumothorax****8***	*Haemothorax****9***	*Foreign body(bullet)****10***

Treatment			
*Advice/Analgesia/Antibiotics****1***		*Dressing/ POP****2***	*Observation****3***
*Suture****4***	*Open operation****5***	*Removal of bullet* ***6***	

Disposal from Trauma Unit				
*Absconded****1***	*Home /GP****2***	*Day Hospital****3***	*Other Hospital****4***	*Outpatient****5***
*Trauma ward****6***	*Other ward****7***	*ICU****8***	*Theatre****9***	*Died****10***

Surgical intervention:	*Yes****1***	*No****2***	***Complications/death***	*Yes****1***	*No****2***
Length of hospital stay			***Length of ICU stay***		

Appendix 2 - Red Cross Children's Hospital's trauma sheet



TRAUMA UNIT RECORD

M 097008
(M =1000000)

RED CROSS WAR MEMORIAL CHILDREN'S HOSPITAL

RX15

Sticky label .....

SURNAME (24) RACE/SEX (25)

FIRST NAME (26–37) FOLDER NO. (38–45) DATE OF BIRTH (45–53)

ADDRESS: .....

DATE (54–59) TIME (Nearest hr. 24 hr. clock) (60 61) HOURS SINCE INJURY (62 63)

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

CAUSE (Mark one code with circle)

TRANSPORT (64-65)
- 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 (66)
- 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 (67)
- 1 Not admitted
- 2 Admitted to Trauma Unit
- 3 Admitted directly to other ward/ICU

DISPOSAL FROM TRAUMA UNIT (68-69)
- 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 (70)
- 1 No
- 2 Yes

SHOCK (71)
- 1 No
- 2 Yes

RESUSCITATION (72)
- 1 None
- 2 Simple
- 3 Complex

ANAESTHETIC (73)
- 1 None
- 2 Local/Regional
- 3 General

SELF INFLICTION (74)
- 1 No
- 2 Yes

ABUSE (74)
- 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.	(76)			(81)
2.	(82)			(87)
3.	(88)			(93)
4.	(94)			(99)

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 Wrist
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/HIF
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		HISTORY
Hb		
Wt		PMH:
EMERGENCY DRUGS		
		EXAMINATION

Signature. ..... *Print Name.* .....

Appendix 3 - Mortuary Data Collection Form

Code No		***Year Of Injury***		***Age***		***Sex***	***M***	***F***
Site of injury:								
Head ***1***	*Face* ***2***	*Neck* ***3***	*Chest* ***4***	*Upper limb* ***5***				
Abdomen ***6***	*Lower limb* ***7***	*Back* ***8***	*Genitalia* ***9***	*Buttock* ***10***				

Appendix 4- Ethics Approval from the HREC – UCT

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Faculty of Health Sciences Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: sumayah.ariefdien@uct.ac.za

14 May 2012

HREC REF: 233/2012

Dr S Sammour
c/o Dr T Welzel
Emergency Medicine
Surgery

Dear Dr S Sammour

PROJECT TITLE: EPIDEMIOLOGICAL REVIEW OF PAEDIATRIC FIREARM INJURIES AND MORTALITIES IN CAPE TOWN, SOUTH AFRICA

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

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

Approval is granted for one year till the 28 May 2013.

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

Please obtain permission from the medical superintendent at Red Cross Children's Hospital and Tygerberg Hospital in order to access patients' records for medical research purposes.

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

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Federal Wide Assurance Number: FWA00001637.
sAriefdien

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

10 July 2012 **MAILED**

Dr S Sammour
Dept Emergency Medicine
University of Cape Town

Dear Dr Sammour

"Epidemiological review of paediatric firearm injuries and mortalities in Cape Town, South Africa."

ETHICS REFERENCE NO: UCT 11

RE : ETHICS APPROVAL

We acknowledge receipt of documents pertaining to the above study and the approval letter from the UCT Human Research Ethics Committee, for this project.

The approval of the UCT HREC is recognised by the Stellenbosch University Health Research Ethics Committee for this particular project. However please continue to keep us informed of the progress of the project, by submitting annual progress reports.

Please note that research that will be conducted at any tertiary academic institution also requires approval from the relevant hospital manager.

Yours faithfully

MR FRANKLIN WEBER
RESEARCH DEVELOPMENT AND SUPPORT
Tel: +27 (0)21 938-9657 / E-mail: fweb@sun.ac.za
Fax: +27 (0)21 931-3352

Appendix 5- Stellenbosch University approval letter

Appendix 6 Division of Forensic Medicine approval letter

UNIVERSITY OF CAPE TOWN

Division of Forensic Medicine
Medical School Anzio Road Observatory 7925 South Africa
PO Box 13914 Mowbray 7705 South Africa
HEAD of DIVISION Professor Lorna J Martin M Med Path [Forens]
Tel: 021 447 1496/7 or 406 6412
Fax: 021 4481249

10 January 2013

Dr Shadi Sammour
Division of Emergency Medicine
University of Cape Town
shdo9@yahoo.com

Request to Conduct Study

Dear Dr Sammour

Permission is hereby granted to you to conduct your research about gunshot injuries and fatalities in children in Cape Town by accessing records held in the Division of Forensic Medicine in accordance with the approval from the Ethics Committee.

Yours faithfully

Dr Gavin Kirk
MBBCh, Dip For Med (SA), FC For Path (SA)
Acting Head of Department

Appendix 7 Tygerberg hospital approval letter

Western Cape Government
Health

Tygerberg Hospital and
Mitchells Plain & Tygerberg Oral Health Centres
REFERENCE: Researches
ENQUIRIES: Dr M A Mukosi
TELEPHONE: 021 938-5966

Dr Shadi Sammour
Division of Emergency Medicine
University of Cape Town

Dear Dr Sammour

PERMISSION TO CONDUCT YOUR RESEARCH AT TYGERBERG HOSPITAL

PROJECT TITLE: EPIDEMIOLOGICAL REVIEW OF PAEDIATRIC FIREARM INJURIES AND MORTALITIES IN CAPE TOWN, SOUTH AFRICA

Permission is hereby granted for you to access the medical records for abovementioned retrospective study.

Yours faithfully

DR M MUKOSI
MANAGER: MEDICAL SERVICES RESEARCH
Date: 25/05/2012

Administration Building, Francie van Zijl Avenue, Parow, 7500
tel: +27 21 938-5966 fax: +27 21938 6698
Private Bag X3, Tygerberg, 7505
www.capegateway.gov.za

Appendix 8 - Tygerberg Hospital's trauma sheet

00-11

TYGERBERG HOSPITAL

DEPARTEMENT SURGERY/TRAUMA
TRAUMA STATISTICS

Trauma Officer: .....

PATIENT DATA LABEL:

(LABEL)

File nr:

	DD	MM	YY	HH	MM
INJURY DATE					
ARRIVE DATE					

REFERRAL FROM:

MECHANISM OF INJURY

ASSAULT

Sharp X99.9	Blunt Y00.9	Gunshot X95.0	Bodily force Y04.8	Fire X97	Child abuse Z61.6	Pushing from train Y01.9	Sexual Y05.0	Human Bite W50.9

Spouse/Partner Y07.0	Parent Y07.1	Friend Y07.1	Official authorities Y07.3	Specified person Y07.8	Unspecified person Y07.9

ROAD ACCIDENTS

Vehicle		Pedestrian	Motorbike		Cyclist collision with		Cyclist collision with others				Railway accident		
V49.4 Driver	V49.5 Passenger	V09.2 Motorcar	V29.4 Driver	V29.5 Passenger	V19.9 Motorcar	V14.9 Bus	V01.0 People	V10.1 Animals	V11..9 Another cyclist	V12.9 train	V05.0 Pedestrian	V25.1 Motorbike	V46.3 Car

FOREIGN BODY

Eye T15.9	Ear T16	Nostril T17.1	Esophagus T18	Through the skin W45	Anus & rectum T18.5

FALL

Slipping/,stumbling W01.0	Skate boards rollerblades W02.0	Carried by a person W04.0	Bed W06.0	Chair W07.0	Playground W09.0	Steps/stairs W10.0	Ladder W11.0	Scaffolding W12.0	Struck by equipment W21.0
Building or structure W13.0	Tree W14.0	Cliff W15.0	Diving / jumping W16.0	level to another W17.0	Same level W18.0	Moving object Y30.9	Bicycle V18.4	Train V81.9	Struck by other object W22.0

DOMESTIC ACCIDENTS

Caught, jammed between object W23.0	Cutting by glass W25.9	Sharp object Y28.9	Blunt object Y29.9	Struck by falling object W20.9	Bumped into another person W51.9	Non Powered tools W27.9	Powered tools W29.0	Handgun discharge W232.9	Fireworks W39.0

SUICIDE ATTEMPTS

Sharp object X78.0	Hanging X70.0	Gunshot X74.9	Flames/fire X76.9	Jumping from high place X80.0	Lying before moving vehicle X81.0	Jumping before moving vehicle X82.0

BURNS

Hot drinks X10.0	Hot water X11.0	Steam X13.0	Household appliances X15.0	Electric current T75.4
Machinery W31.9	Air /Gases X14.0	Fire in building X00.9	Exposure to fire & flames Y26.9	Explosive material Y25.9

WORK RELATED Y96.X	*DOGBITE W54.0*	*SPORT INJURY W27.9*	*NEAR DROWNING Y21.9*	*FOLLOW-UP Z48.8*	*OTHER Y34.9*	

FINAL DIAGNOSIS (ICD 10 CODES)

TEMP:	PULSE:	BLOOD PRESSURE:	Hb:	Hgt:

History .....

.....

.....

Urine : Glucose.....

Protein.....

Ketones.....

Blood .....

PREVIOUS MEDICAL HISTORY

Hypertension I15.9	Diabetes E14.8	Isch Heart Disease I25.9	Obstr. Lung Disease J44.9	Epilepsy G40.9	Porphyria E80.2
Psychiatric illness F09.X	TB	Other			

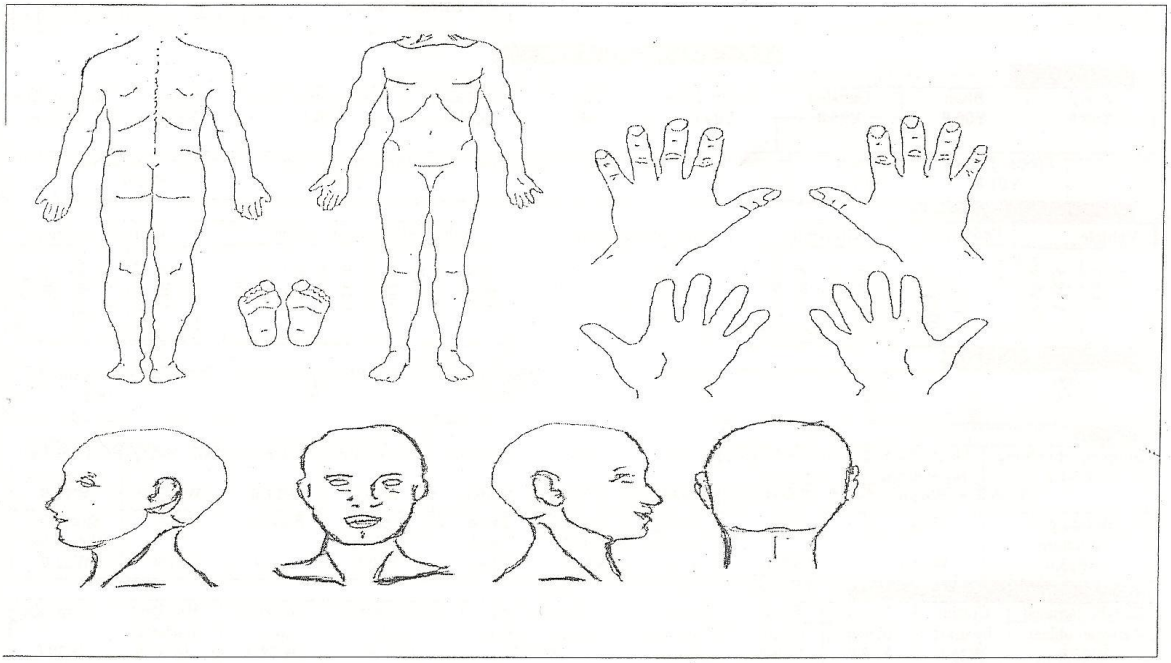
ALLERGIES				
CENTRAL NERVOUS SYSTEM	Pupils (R)	(L)	Consciousness Level	
MEDICATION				
GLASGOW COMA SCALE	Eye Response	Verbal Response	Motor Response	TOTAL

LOCALISING SIGNS .....

.....

.....

FRACTURE △ DISLOCATION □ LIGAMENT ▒ ABBRASION ○ CONTUSION



COMMENTS .....

.....

HEAD.....

NECK .....

CHEST .....

.....

ABDOMEN .....

.....

PELVIS.....

.....

LIMBS.....

.....

VASCULAR STATUS .....

.....

PERIPHERAL NERVES

PLAN OF ACTION

.....

.....

.....

.....

.....

Signature and Rank: .....

11-1	X-RAY NO:

RADIOLOGY REQUEST AND REPORT

REQUEST:

LAST MENSTRUATION .....

ARRIVAL TIME:

		H		

TIME COMPLETED

		H		

ROOM: .....

RADIOGRAPHER .....

35X43: 24X30:

35X35: 18X24:

30X40: 17X43:

20X40: OTHER

DOCTOR .....

SIGNATURE .....

DATE ...../...../.....

: REPORT

DATE	TIME	RADIOLOGIST	NAME IN PRINT

Trauma 12.2

Department	Time of Referral	Plan of Action	Doctor
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

(ADDITIONAL NOTES)

TREATMENT MANAGEMENT	NURSING ACTION	
1. Tetanus Toxoid 0,5 ml B/S	TIME	ADMINISTERD BY: SIGNATURE + RANK
.....	...../.....	.....
.....	TIME	ADMINISTERD BY: SIGNATURE + RANK
2. Medicine:	...../.....	.....
.....	...../.....	.....
.....	...../.....	.....
.....		

CLEANING LIQUID				DRESSING		SUTURE MATERIAL
NaCl	Povidone	Hibidil	Other	Dry	Betadine	

PRESCRIPTION Or EQUIVALENT

Date	Prescription of Medicine	Quantity Eg: 1x 20 Tablet Pack	Signature of Doctor	Issue by:
.....	.....	.....	.....	
.....	.....	.....	.....	
.....	.....	.....	.....	

ATE OF DISCHARGE: ...../...../.....

DOCTORS SIGNATURE.....

Appendix 9 - Forensic pathology data sheet

CONTEMPORANEOUS NOTE (LAB. 27) : SALT RIVER FORENSIC PATHOLOGY LABORATORY

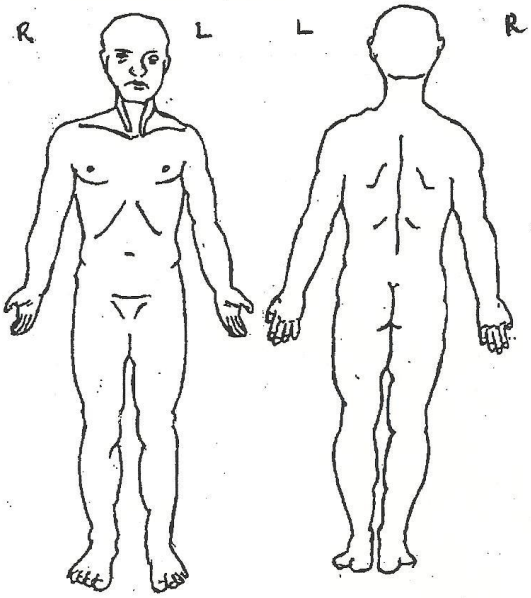
WC/11/_____ PATHOLOGIST _____ BODY BAG SEAL NO _____

ASSISTANT _____ DATE OF PM _____ TIME OF PM _____

1. RACE: White | Coloured | African | Asiatic
2. GENDER: Male | Female
3. AGE: _____
4. NAME OF DECEASED: _____
5. AREA OF DEATH: _____
6. SAPS STATION: _____
7. DATE OF DEATH: _____
8. TIME OF DEATH: _____
9. DIED IN:

House	Shack	Road	Dam	River
Swimming pool	Bucket / Bin	Shebeen	Sea	Lake
Hospital	Railway track	Open land	Toilet	Other

HISTORY _____



EXTERNAL FEATURES _____

CHIEF POST-MORTEM FINDINGS

1.
2.
3.
4.
5.

CAUSE OF DEATH _____

ALCOHOL SEAL NUMBERS Received by:	Inner	Outer
Exhibits received by:		
Photographer:		

Signature: _____