

A long walk to freedom: the epidemiology of penetrating trauma in South Africa – analysis of 4 697 patients over a six-year period at Chris Hani Baragwanath Academic Hospital

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Background: Despite the city of Johannesburg having one of the highest rates of crime in the world, no national databank for trauma exists. This study profiles the victims of penetrating trauma and identifies geographical areas in which it occurs, while describing the outcomes and patterns of injury.

Methods: A retrospective study including penetrating trauma patients triaged as Priority 1, presenting at the Chris Hani Baragwanath Academic Hospital's (CHBAH) trauma department over a six-year period (2011–2016).

Results: A total of 4 697 patients were included. The majority of victims were Black African males (92.1%) between the ages of 29–40 years, and stabbings were the most common mechanism of injury (71.8%), followed by gunshots. The commonest body area affected was the thorax, with a consequent haemothorax the most likely result. Weekends accounted for over 48% of all presentations – the last weekend of the month being the busiest. Region D was the area in Johannesburg with the highest trauma incidence (51.9%), with the oldest townships in Soweto found to be “hot spots”.

Conclusion: Penetrating trauma is inherently linked to alcohol abuse and interpersonal violence in South Africa,¹ primarily affecting its young economic, working-class citizens. The data provided some insight into the burden, structure and challenges of our trauma system. These should be regarded as opportunities to implement change and improve our surveillance and prevention, beginning with a national trauma databank.

Keywords: trauma systems, penetrating trauma, South Africa, Soweto

Introduction

South Africa is a developing country with an exceptional past, our legacy is that of a prolonged freedom struggle, characterised by singular political violence and state-mandated oppression. Defined by constitutional racial seclusion and exploitation, this has finally given way to a non-racial democracy. At its core, the political conflict has largely receded, yet alarmingly high levels of interpersonal violence remain, fuelled by rapid urbanisation and continuing socioeconomic inequalities. News of violent crime frequently makes headlines, and Johannesburg is now regarded as one of the most dangerous cities in the world – with the Gauteng province consistently having the highest gross numbers for murder for the 2010–2018 period.^{2,3}

According to the Statistics South Africa Report on the mortality and causes of death in 2016, more than a tenth of all deaths that occurred in South Africa were due to external causes of morbidity and mortality.⁴ The majority of these non-natural causes of death (66.5%) are classified as other external causes of accidental injury – of which penetrating trauma (falling under exposure to inanimate mechanical forces) accounted for 17.4% in this group – comprising of discharge from firearms as well as contact with a knife or sharp object. Assault was found to be the second most

common non-natural cause of death, accounting for just over 14%.⁴ Alcohol has further been found to be a prominent factor in violence and injuries, including interpersonal violence, domestic violence, sexual assault and road traffic injuries.⁵

Statistics for South Africa also indicate that for both sexes, the age group most affected by non-natural causes of death is the age group 20–24, contributing to 47.9% of all deaths in this age cluster.⁴ A study conducted at Groote Schuur Hospital in Cape Town, South Africa, demonstrated that males were the more likely victims of penetrating violence with a higher percentage of injuries sustained through firearms and sharp objects than their female counterparts.⁶ These figures highlight the fact that young males are the most common victims, and considering that this is the most important and productive population group with respect to educational training and workforce, it follows that it would have subsequent grave consequences for the national economy.

In order to abate mortality in cases of penetrating trauma, risk factors for mortality need to be methodically identified and considered. A review of trauma-related mortality carried out in Pietermaritzburg – an urban metropolitan complex of hospitals – suggests that there is considerable room for

improvement in trauma prevention, with underdeveloped trauma systems and a high mortality rate contributing to a substantial number of avertible deaths.⁷ On scrutiny of the literature, the apparent scantiness of epidemiological data on trauma in South Africa is revealed, highlighting the fact that we have no national trauma database. While a national trauma database in the USA – which has been adapted worldwide in other countries – was initiated by surgeons after intense review of the medical services offered to trauma patients,⁸ no such initiative has been instituted in our country despite our high trauma volumes. Mortality rates and mortuary records go some way in revealing the trauma burden, however, they do not take into account all penetrating trauma as not all incidents are reported, and unless they result in a mortality and post-mortem, may not be noted in our national statistics database. Trauma is an epidemic in South Africa, yet government leadership has not undertaken the task of addressing the issue with a database. Barriers to this task include lack of standardised hospital data formats, resource constraints and inadequate pre-hospital care services.

Over the last decade, this shortcoming has been recognised, and a move made by individual hospitals to initiate and mature electronic-based systems that allow for quick and accurate data capturing. Major trauma systems in KwaZulu-Natal and the Western Cape are two such systems that have implemented electronic registries.⁹ The Pietermaritzburg Metropolitan Trauma Service in KwaZulu-Natal is one such system that has developed and implemented an electronic database for patients presenting to their hospital complex, allowing them to quantify their trauma burden and examine their patient outcomes. This resulted in them identifying deficits that could be improved on with the aim of optimising trauma care and systems.¹⁰

Gauteng has not yet adopted this approach, and instead a paper-based system is used in Johannesburg, which is then transferred onto an electronic database, with an already overwhelmed clinician expected to bear the brunt of data capturing. Possible reasons this has been slow to be adopted is the lack of funding, limited availability of electronic technology required to capture and access data, as well as an overburdened healthcare system that our country faces with medical concerns like HIV and TB.

The aim of this study was to gauge the demographics, profile and injury patterns of trauma victims in Johannesburg in an attempt to identify problem areas amenable to change and thus improve trauma prevention and trauma systems. It would also serve to highlight the burden of trauma faced in this area of Johannesburg, where trauma numbers are amongst the highest in the country, but with little data published to substantiate the need for an improved trauma registry.

Methods

We undertook a retrospective review of the trauma database at Chris Hani Baragwanath Academic Hospital (CHBAH) in Soweto, Johannesburg – the third largest hospital in the world, which is also a teaching hospital of the University of the Witwatersrand Medical School. This study included patients presenting to the trauma emergency department at CHBAH including those referred from hospitals within its drainage area. The hospital's emergency department receives about 11 100 patients per month, which translates

to approximately 360–420 per day, of which about 65% is trauma related.¹¹ All patients who sustained penetrating trauma and were admitted to the trauma resuscitation area (triaged by a medical doctor as a Priority 1 casualty [P1]) had a Medibank form (an institute-specific form used for data collection) filled out with the relevant patient and injury information, and were then captured onto an electronic database, making the data for this study available. Data was collected from the database for the period 2011–2016.

Statistical analysis

STATA 14 software was used for data management and statistical analysis (StataCorp, 2017, Stata Statistical Software: Release 14, College Station, TX: StataCorp LLC.). The chi-squared test of association and Fisher's exact tests were used to examine associations between categorical variables. Frequencies and percentages were reported for categorical variables. Median and interquartile range (IQR) were used to describe the age distribution and other continuous variables.

Results

Form use and field completion

Data completion rates were highly variable, with some areas well completed and others with low completion rates. The most consistently completed fields were the demographics, i.e., age (100%), arrival date and time (100%), ethnicity and gender (100%). The most poorly completed areas were instrument used (17%) and town/suburb in which the incident occurred (49.1%).

Patient demographics

The analytical sample consisted of 4 697 patients identified as victims of penetrating trauma over the six-year period 2011–2016. The overwhelming majority of the victims (Figure 1) were young males (92.1%), with the median age being 29 years (IQR 24–36). The age distribution is shown in Figure 1 and ranges from < 18 years to > 70 years. The race most commonly involved was Black African at 92.7%, followed by the Coloured race at a much lower incidence of 4.8%. Asians, Indians and Whites collectively made up the remaining 2.5%.

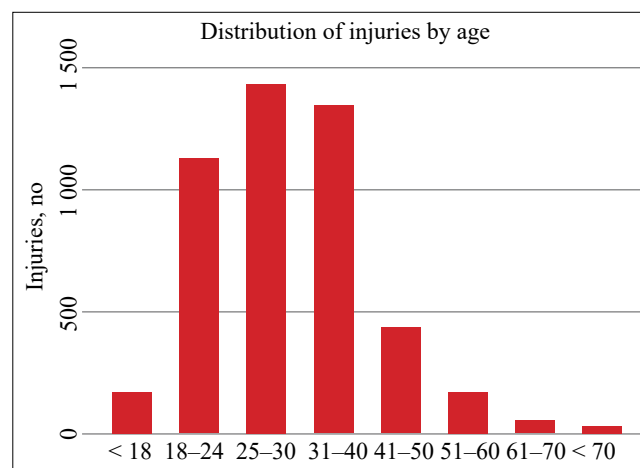


Figure 1: Distribution of injuries by age

Time distribution of injuries

The weekends, with Sunday having an incidence of 24.4% (1 148/4 697), followed closely by Saturday (23.9% 1 122/4 697), were identified as the busiest days with regards to presentation of casualties (Figure 2A). Most of these casualties occurred between 18:00 and 06:00 (Figure 2B). Mondays and Fridays were identified as the busiest weekdays with midweek days dropping and Tuesday (9%; 425/4 697) being the quietest day of the week (Figure 2A).

A further analysis was done looking at whether there were any patterns with regards to which weekends in the month had the highest volume. There were a total of 2 269 weekend days (i.e., Saturdays and Sundays), of these, 611 (27%) fell in the last weekend of the month. The data shows that there was a significant difference in the number of injuries in the last weekend of the month – with the months January, March, April, May and August, showing statistically significant

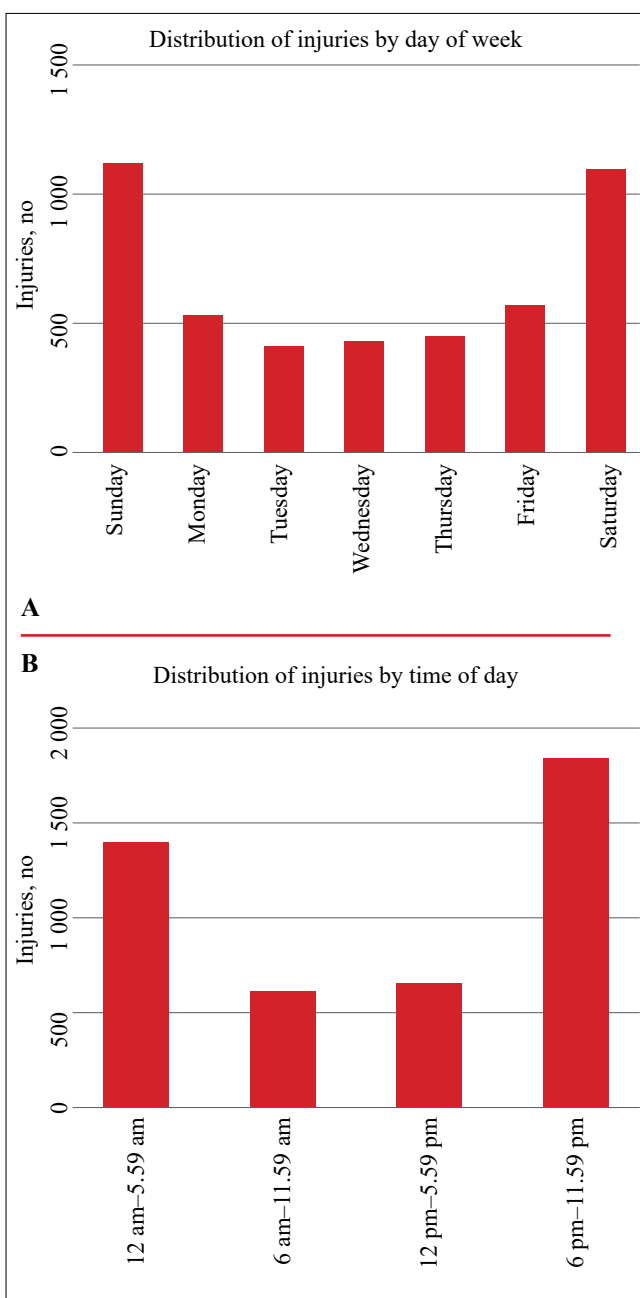


Figure 2: Time distribution of injuries by (A) day of week and, (B) time of day

Season	Freq.	Per cent	Cum.
Autumn	1 051	22.38	22.38
Winter	929	19.78	42.15
Spring	1 550	33.00	75.15
Summer	1 167	24.85	100.00
Total	4 697	100.00	

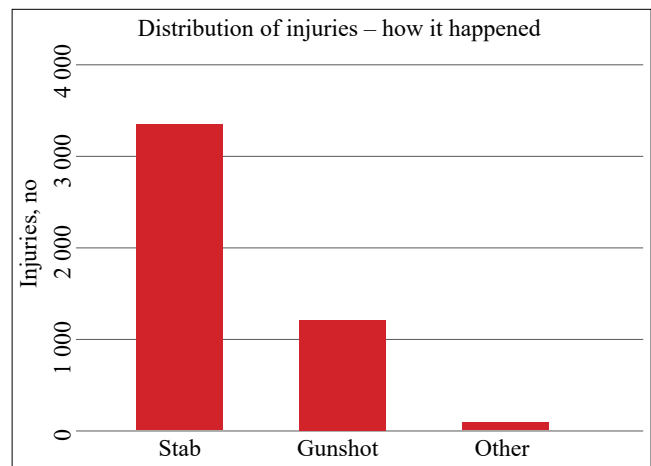


Figure 3: Injury mechanism

increases compared to other weekends ($p < 0.001$). The months were then grouped into seasons, to see if there was an association between incidence of injuries and seasons (Table I). As expected, there were fewer injuries in Winter (19.7%; 929/4 697) compared to all the other seasons.

Injury mechanism and instrument used

The majority of injuries were inflicted by stabbing at 73.1% (3 437/4 697) followed by gunshots (Figure 3) with an incidence of 26.3% (1 239/4 697). A large number of data fields were missing for this section, however, at 82.93% (3 895/4 697) – concerning which instrument specifically was used, i.e., type of gun or instrument used to inflict a stab wound – and thus, no meaningful assessment can be made for that category.

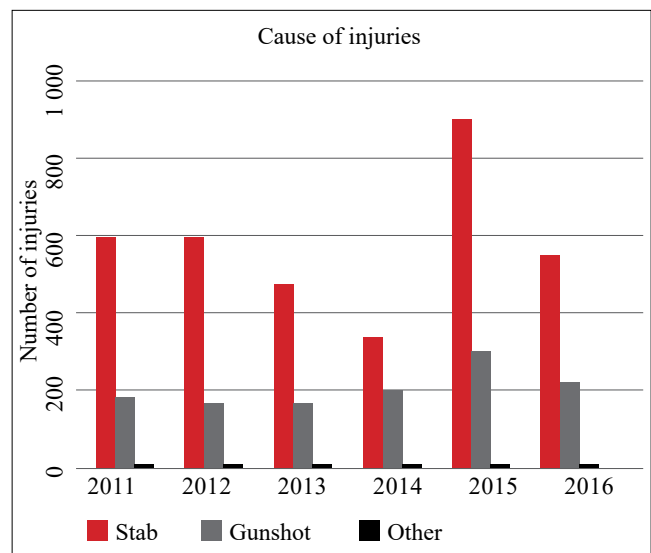


Figure 4: Annual distribution of injury by mechanism

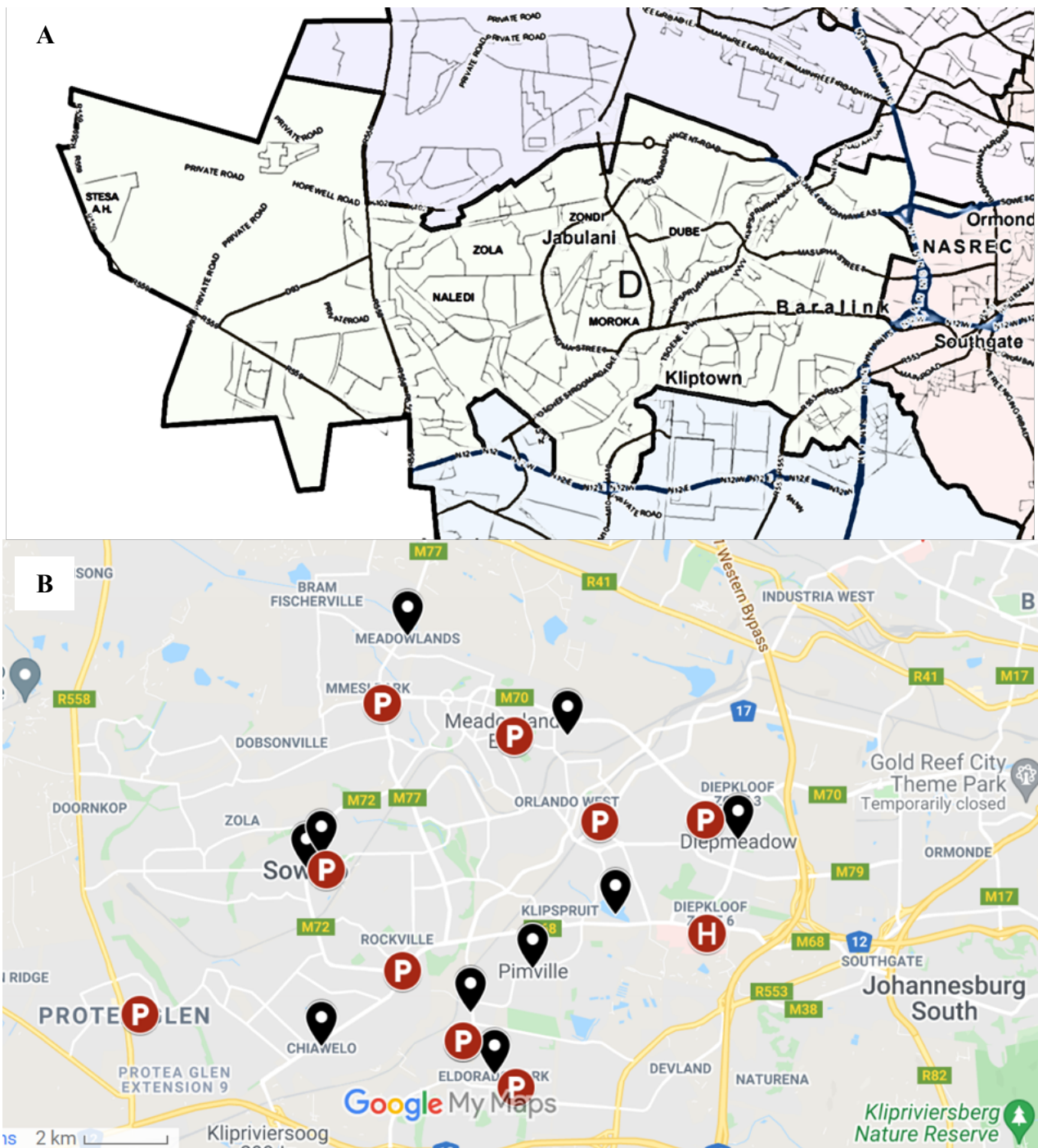


Figure 5: (A) Geographic distribution by region and (B) hotspots within the Region D

Looking at incidence over the years, and since other injuries were very few, we consider changes in incidence of stabbings and gunshots over the study period. Figure 4 shows a significant difference in the incidence of stabbings and gunshots over the six-year period, with 2015 having the highest incidence of both stabbing and gunshots individually, as well as for penetrating trauma collectively ($p < 0.001$).

Geographic distribution of injuries

The distribution of injuries was classified in terms of the Johannesburg region in which they occurred (Figure 5) – with Region D (see Appendix) accounting for the overwhelming majority at 51.9% (1 201/2 310). Injuries were clustered in this

region in Orlando, Freedom Park, Diepkloof, Meadowlands and Soweto being the five areas with the highest incidence reported. Other significant areas included Regions G and F at 34% (790/2 310) and 8% (187/2 310), respectively. A small number of casualties were also received from areas out of CHBAH’s drainage area – including inter-provincial transfers from North West Province and Mpumulanga. The map (Figure 5B) highlights the Region D and marks the 10 highest areas of injury occurrence in relation to the hospital CHBAH (black markers). It has been derived from Google Maps and shows the relation of these areas to the police stations (red markers) situated closest to them.

Mode of transportation

The majority of patients arrived at the hospital by means of ambulance (BLS) (46.2%; 1 710/3 696), with private transport being the second commonest at 25% (926/3 696). A significant number were, however, not recorded (16%; 1 001/4 697).

Body areas affected

The commonest body area involved in penetrating trauma was the thorax, with an overwhelming majority of 44.9% (1 982/4 414), followed by abdominal trauma at 21.9% (971/4 414). The consequence of thoracic injury was 54% haemothorax, a further 40% cases of pneumothorax, and associated cardiac injury found in 4.4% of cases.

Discussion

Quality improvement programmes are an integral part of trauma systems – enabling health care institutions to identify problem areas, scrutinise system errors and take steps to correct these, while implementing changes in attempts to have an impact on trauma mortality. According to the WHO, such systems have been inadequately implemented in most low- and middle-income countries.¹² This development of trauma systems is reliant on unremitting, good quality trauma data and surveillance as no advances can be made without analysing the existing data and circumstances that a system is faced with.

The data in this study confirms what prior studies have concluded – that the overwhelming preponderance of trauma burden in our population falls largely on its economic working class, young Black males in the 25–40 age group. The weekends, followed by Fridays after working hours were the busiest periods, in keeping with what one would expect, as our trauma burden is often associated with alcohol use and assault/interpersonal violence.¹³ The last weekends of the month tend to have the highest statistics, also in keeping with this association, as most people are paid their salary around the 25th of the month and are thus more financially able to engage in social activities and purchase liquor during that subsequent period. A study done at Groote Schuur Hospital in Cape Town showed similar findings with weekends and particularly the end of month weekend being busier than weekdays.¹⁴

South Africa's experience with alcohol both resonates and differs from other countries, with our distinctive past creating an inseparable link with our drinking culture. Workers in the Western Cape were paid wages in alcohol in the "dop system", and in the mining districts alcohol was used as a source of tax as well as a means of regulating labour. This resulted in many in the agricultural and rural communities becoming dependent on alcohol.¹⁵ Black South Africans were also prohibited from selling alcohol or entering licensed premises, leading to drinkers going to illegal bars where they could meet, have open discussions, and express themselves freely. This played a role in unifying people with a sense of community, with many viewing it as an act of rebelliousness against the apartheid regime. While these policies have long ceased, the legacy left remains pervasive in communities.

The association between interpersonal violence and alcohol in South Africa has also long been established.¹³ Alcohol would certainly appear to be a contributing factor in our population with it being readily available. Indeed, there

are in excess of 50 legal alcohol distributors – comprising of townships taverns, shebeens, pubs and liquor stores within a 10 km radius of the ten areas of highest penetrating trauma incidence identified in this study. In reality, the number is likely higher when one considers informal illicit alcohol sales that are often found in informal settlements. According to a paper published on the liquor industry in South Africa,¹⁶ the biggest problem patterns identified were heavy episodic drinking, high levels of youth drinking and the illegal alcohol sector.

This is a topic that has recently been highlighted in the time of the COVID-19 pandemic, when trauma incidence dropped dramatically following alcohol restrictions with a more than 50% reduction in all trauma cases noted by a study in Cape Town.¹⁷ A study done at Gray's Hospital in Pietermaritzburg similarly demonstrated a significant decrease in the number of penetrating trauma cases seen as a result of alcohol and travel bans.¹⁸ Similar findings were reported in Sweden where extensive experiments and studies have been performed with regards to reform on alcohol policies. One such experiment involved closing of alcohol stores on a Saturday, which was continued for a period of more than a year, resulting in a net 10–12% decrease in assault in the Friday/Saturday period as well as decreased levels of domestic violence.¹⁹

When analysing the results of the geographical distribution of trauma, it is imperative that we take a step back into the city's history. The city of Johannesburg began as a settlement in 1886 with the discovery of gold by prospectors and has subsequently grown from small settlements into a prosperous metropolitan city. It can be divided into regions or suburbs – each grappling with specific individual struggles, as a result of our political history in the era of Apartheid. Region D, with the highest penetrating trauma incidence as highlighted in this study, is situated in the southwest of the greater metropolitan area, and has been called the "heir to poverty," with a population exceeding 1 million.²⁰ It faces major challenges due to lack of urban planning, high rates of poverty and the social issues stemming there from. This area encompasses Soweto in its entirety, of which Orlando was the first township established.

The highest rates of penetrating trauma highlighted in this study occurred in the areas of long-established townships, i.e., Diepkloof, Meadowlands and Orlando, where large informal settlements make up the majority of the housing. In fact, the ten "hot spots" of crime identified in this study all fell within this Region D. This raises some interesting questions. Are we seeing the legacy of our violent past reverberate across the generations in a community as in the case of holocaust survivors in whom studies have suggested that the effects of trauma may be intergenerationally transmissible through hormonal and epigenetic processes?²¹ A number of empirical studies have demonstrated that communities who have histories of trauma are more vulnerable to diminished mental health in later generations.²² Alternatively, is this merely the rebuttal of a community facing ongoing struggles with poverty, a mass influx of migrants seeking work and failing to receive the basic rights that they require?

Furthermore, these identified crime "hot spots" all fell within a 10 km radius of the CHBAH itself. This implies that medical care or hospital access should be readily accessible. This study further revealed that a large number of casualties present in the early hours of the morning – arriving either

via basic ambulance support services or via private vehicle. Delays in presentation could thus be attributed to a possibly overwhelmed ambulance service in those busiest hours or delays in seeking medical care due to social circumstances and possibly circumstances in which the injury was sustained, i.e., criminal offenses such as assault or use of illegal weapons.

As the maps (Figure 5) highlight – there are a number of police stations in the vicinity of these areas of high incidence which doesn't appear to impede the high rates of crime and interpersonal violence that occur here. Postulates arise in which police services are unable to respond adequately to the community needs or the police services may be overwhelmed with inadequate numbers and scanty support for the volume of crime that must be dealt with. A crime response app Namola – with more than 400 000 users, works like the 911 emergency number in the US where emergency services can be reached via a call centre who will contact the SAPS or other relevant authorities on your account. According to their data, the commonest single type of request is for an ambulance service, with citizens in Soweto reportedly requesting assistance more than in any other area,²³ suggesting that there is a community faction reaching out for help. This is yet another area that needs to be looked into with possible intensified police presence and roadblocks during the busy periods.

It is important to note that there were many inherent limitations to this study. Incomplete forms being a large part of this, exacerbated by the large trauma burden. It is inevitable that the high patient burden, such as the one faced at CHBAH, presents many challenges such as a resource limited setting with staff continuously inundated with the clinical load. Medibank forms used to keep records are paper-based and labour intensive, needing a significant amount of time to be set aside to capture the required information. In a practical setting, this is extremely challenging when faced with such high patient volumes.

The form itself could possibly be modified in a number of ways, including more clarity regarding classification of injuries. Ongoing education and an on-site facilitator could also help as the forms are often filled out by junior staff members without a full understanding of the form and its implications. An electronic-based system and the hiring of additional staff members designated to data capturing may also go lengths in improving the completeness of patient records as well as the quality of data captured.

Conclusion

The burden of penetrating trauma in Johannesburg is diverse, multi-fold and closely linked to interpersonal violence and alcohol use – with the majority affecting young males in Soweto on weekends in the early hours of the morning. This data is a mere glimpse at the tip of the iceberg. It does not account for blunt trauma or victims sustaining less severe injuries (triaged other than P1) presenting to the trauma casualty. Despite the shortcomings, however, this analysis provides some intriguing insights into the burden, structure and challenges of the trauma system at CHBAH, and each of the areas represented should be regarded as stimulating new opportunities to implement change and improve trauma surveillance.

In South Africa, an entire systems change must be undertaken, where key issues in society including mental

health, social factors and economic disparities are appropriately addressed. It now lies with healthcare workers to initiate the necessary change because this burden is unquestionably the responsibility of and is carried by all of society. This can begin with a national trauma databank. In the words of our beloved leader Nelson Mandela, “The truth is that we are not yet free; we have merely achieved the freedom to be free, the right not to be oppressed. We have not taken the final step of our journey, but the first step on a longer and even more difficult road. For to be free is not merely to cast off one's chains, but to live in a way that respects and enhances the freedom of others.”

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Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

This study was approved by the University of Witwatersrand Human Research Ethics Committee.

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Appendix available online.
