



## The cost of treating serious abdominal firearm-related injuries in South Africa

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**Introduction.** Firearms, the leading external cause of non-natural deaths in South Africa, claim approximately 15 000 lives annually. Up to 127 000 firearm-injured victims seek state health care assistance per annum. The fiscal burden of treating these injuries is not known.

**Methods.** All serious abdominal firearm-related injuries (requiring admission to hospital and emergency surgery) presenting to a state hospital over a 6-month period were reviewed. A cost analysis using five variables was performed: operating theatre time, duration of hospital and high-care unit stay, pharmaceutical and blood products used, laboratory services used and diagnostic imaging studies performed.

**Results.** Twenty-three patients with serious abdominal gunshot injuries were admitted, of whom 21 (91%) were treated at the

hospital from admission until discharge. Each admission cost approximately US\$1 467. Hospital stay (47%) and operating theatre (30%) costs accounted for most of the total cost. Pharmaceuticals and blood products (20%), laboratory services (2%) and imaging studies (1%) contributed less than 25% to the total cost.

**Conclusion.** Serious abdominal gunshot injuries cost at least 13-fold more than the annual per capita South African government expenditure on health. This fiscal burden of approximately US\$2.9 million, almost 4% of the annual health budget, does not include the cost of treating other serious gunshot injuries. These findings highlight the need for successful violence prevention strategies in South African.

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There are approximately 4.5 million registered firearms in circulation in South Africa (SA),<sup>1</sup> a country of almost 45 million people. Another 1 million weapons are estimated to be illegally held.<sup>1</sup> It is therefore not surprising that a recent survey of more than 25 000 non-natural deaths<sup>2</sup> conducted by the National Injury Mortality Surveillance System (NIMSS) identified firearms as the leading cause of non-natural death in SA. Approximately 45% of surveyed deaths were due to homicide, of which 50% were due to firearm injuries. If a national estimate of 70 000 non-natural deaths per year<sup>2</sup> is used, it can be assumed that at least 15 500 people die from firearm-related injuries per annum in SA, a country not at war. This translates into the second highest firearm-related homicide rate (27/100 000) in 69 countries recently surveyed by the United Nations<sup>3</sup> (Table I). While the national homicide rate provides good evidence of the extent of fatal firearm violence, the rates for firearm-related homicide in large urban centres far exceed the national average: Johannesburg (63/100 000), Durban (48/100 000) and Cape Town (40/100 000).

The mortality burden of firearm injuries is clearly excessive, but the burden of non-fatal firearm-related injuries is estimated to be far worse. A pilot study conducted by the National Non-fatal Injury Surveillance System (NANFISS)<sup>4</sup> confirmed the high prevalence of interpersonal violence (53% of 1 122 patients surveyed), and reported firearm-related trauma in at least 16%

**Table I. Firearm-related homicide rate**

Country	Firearm-related homicide rate (/100 000 people)
Columbia	54.0
South Africa	26.6
Brazil	25.8
USA	6.2
Canada	0.6
Australia	0.4
UK	0.1

of cases injured as a result of violence. On the basis of this information it seems likely that about 127 000 non-fatal firearm injuries are treated at SA state hospitals each year.

The cost of rendering emergency treatment to this burden of firearm-related trauma has not been estimated to date. A study conducted at Groote Schuur Hospital (GSH), one of the three largest university-affiliated state hospitals in SA, found that almost 42% of 969 patients presenting with firearm-related injuries required surgery.<sup>5</sup> Abdominal firearm-related injuries ( $N = 161$ ), accounting for almost 17% of presentations, were the most expensive to treat. It seems reasonable to estimate that at least 20 000 emergency operations for abdominal firearm-related injuries are performed annually in SA state hospitals. Determining the minimum cost of treating serious abdominal gunshot injuries, i.e. those requiring admission to hospital and emergency surgery, would provide some perspective of the overall fiscal burden borne by the SA health care budget, already stretched by an AIDS epidemic of extreme proportions.<sup>6</sup>

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The aim of this study was to determine the minimum inpatient cost of treating serious abdominal firearm-related injuries in the SA state health care sector.

## Methods

The study was conducted at G F Jooste Hospital (GFJH), a 188-bed state hospital within the municipal boundaries of Cape Town. The folders of all patients who underwent emergency surgery for a firearm-related abdominal injury during the 6-month period 1 October 2002 - 30 April 2003, were reviewed. A cost analysis, based on five variables, was performed. All costs were calculated in South African rands (ZAR) and then converted to US dollars (US\$) using an exchange rate of 1 US\$ = 7 ZAR (December 2003). Values were rounded off to the nearest US\$. The five cost variables studied were: (i) operating theatre time (ZAR per minute); (ii) duration of hospital stay, including high-care unit admission, in days (ZAR per day); (iii) therapy, i.e. pharmaceuticals and blood products (ZAR per unit); (iv) laboratory services used (ZAR per unit); and (v) diagnostic imaging studies performed (ZAR per unit).

Operating theatre costs (US\$3.4 or ZAR24 per minute) and duration of hospital stay (general ward US\$74 or ZAR518, high-care unit US\$198 or ZAR1 384) costs were calculated using standard cost tables published annually by the Department of Health. These standard daily costs include labour costs (professional, nursing, administrative and manual). The total cost of pharmaceuticals (perfusion fluids, medication, blood products) used per patient, from the time of admission until discharge, was calculated using standard pharmaceutical products cost tables. These tables (published annually by the Department of Health) reflect the latest government tender prices of perfusion fluids and medication available in the state health service. These prices do not include professional labour costs. The cost of blood products used was determined using the most recent price list issued by the South African Blood Transfusion Service (SABTS). These annual price lists reflect the cost of materials used, labour and transport. The cost of laboratory services used was calculated using standard cost schedules published annually by the SA National Laboratory Services. These rates include the cost of materials

used, maintenance and labour. Diagnostic imaging study costs were calculated using standard rates quoted for state health care services. These rates include the cost of materials only. All data were captured on checklists and entered onto Excel spreadsheets. Descriptive parameters were calculated using the Statistica 6 software package (StatSoft Inc, Tulsa, USA).

## Results

During the period studied, 128 patients required emergency thoracotomies or laparotomies for penetrating trauma (gunshot or sharp implement, e.g. knife) of the chest or abdomen. Of these, 23 patients required emergency laparotomy for gunshot injuries of the abdomen, i.e. an average of 1 gunshot-related laparotomy per week. Twenty-one of the 23 patients (91%) were managed at GFJH from admission until discharge. Two patients were transferred postoperatively; 1 required transfer to GSH and 1 requested transfer to a private health care facility. All 21 patients discharged from GFJH were alive 1 month after their operation.

Table II highlights the variation in cost for each of the variables studied. The average cost per variable, expressed as a percentage of the total cost, was: 47% for hospital stay, 30% for operating theatre, 20% for pharmaceuticals and blood products, 2% for laboratory services, and 1% for imaging studies. The most expensive unit of cost per patient was hospital stay: median cost US\$592 for an average stay of 6.5 days. The median cost of theatre facilities was US\$444 per patient (average operating time of approximately 130 minutes per laparotomy). Overall, money spent on laboratory services and diagnostic imaging studies was limited by the very selective use of investigations postoperatively. Less than 50% of patients (10 of 21) underwent laboratory tests postoperatively, only 19% (4 of 21) required tests in excess of US\$50, and expensive imaging studies, costing more than US\$50 per unit, e.g. computed tomography (CT) of the abdomen, were performed on 1 patient only (Table II).

As shown in Table II, the hospital spent a minimum of US\$30 803 on the treatment of 21 abdominal gunshot victims over a period of 6 months. On average, each victim cost the state health service US\$1 467 (approximately ZAR10 269).

**Table II. Cost analysis per variable (N = 21)**

	Basic minimum cost (US\$)					Total
	Operating theatre	Hospital stay	Therapy and blood products	Laboratory services	Imaging studies	
Total	9 326	14 625	6 081	548	223	30 803
Mean ± SD	444 ± 194	696 ± 441	290 ± 406	26 ± 47	11 ± 22	1 467 ± 984
Median	411	592	86	4	6	1 106
(range)	137 - 926	193 - 1 802	11 - 1 425	0 - 207	0 - 105	303 - 4 345

**Table III. Annual per capita expenditure on health**

	Per capita expenditure on health per annum (US\$)	
	Total expenditure	Government expenditure
Top five developed world countries		
USA	4 887	2 168
Switzerland	3 774	2 146
Canada	2 163	1 490
UK	1 835	1 508
Australia	1 741	1 246
Top three African countries		
South Africa	222	106
Botswana	190	107
Namibia	110	87

## Discussion

This paper, using the best available information, provides a reasonable estimate of the minimum in-hospital cost of treating serious abdominal firearm-related injuries at a second-level SA state hospital. For the purpose of this paper, serious firearm-related injuries were defined as gunshot injuries requiring admission to hospital and emergency surgery. While an average cost of US\$1 467 (ZAR10 269) still underestimates the total in-hospital expense per patient (e.g. labour costs were not factored into all the used government cost tables), the data provide a meaningful estimate of the minimum cost using well-defined cost units. The only other study attempting to calculate the fiscal burden of gunshot injuries in SA estimated the hospital cost of serious abdominal firearm-related injuries to be about ZAR8 564 per case in 1993.<sup>5</sup> Unfortunately the cost units evaluated in this paper were not well described. Comparison of the data presented in these two papers should therefore be done with caution. However, if it can be assumed that health care costs in SA have increased by at least 10% over the past 10 years (1% per annum), then both papers suggest that each serious abdominal gunshot injury currently costs the SA state health care system an average of more than ZAR10 000 (approximately US\$1 400). By developed world standards this per capita health expenditure does not seem excessive (Table III).<sup>7</sup> However, this figure represents an amount 13-fold greater than the annual per capita government expenditure on health in SA in 2001 (Table III). Even in SA, which has the highest annual per capita government health expenditure on the African continent,<sup>7</sup> the fiscal burden of serious abdominal firearm-related injuries exceeds the per capita state health care expenditure by a wide margin.

By extrapolating the findings of this study, the national cost of firearm-related injuries in SA starts to become apparent. Serious abdominal firearm-related injuries alone may be

costing the SA government up to ZAR200 million (US\$2.9 million) per annum. This figure, roughly equivalent to 4% of the total national government expenditure on health per year,<sup>7</sup> is potentially being spent on less than 0.05% of the SA population – and does not include the cost of other serious firearm-related injuries, e.g. gunshot wounds of the head, neck, chest, spine or limbs, requiring hospital admission and surgery. Although this estimated expenditure represents only a fraction of the total cost per annum, the basic observation relevant to health care planning in SA is clear. The allocation of insufficient resources to manage the massive firearm-related burden of trauma in SA may ultimately compromise the care of non-trauma patients competing for access to the same health care resources.

Not only does the firearm-related trauma burden in SA exceed national fiscal resources, but it also threatens to exceed human resources in SA. Doctors in the public health system, currently employed at a rate of 22 per 100 000 population,<sup>8</sup> provide health care services for the almost 85% of SA residents who do not have any form of private health insurance.<sup>9</sup> This means that at least 56 of every 66 (per 1 000 population) trauma cases seeking medical attention will be treated by doctors working in the public health care system. From this limited analysis, it is apparent that the trauma burden currently exceeds both financial and human public health care resources in SA.

A criticism of this paper may be that it reflects the experience of only one hospital treating serious abdominal firearm-related injuries in the SA state health sector. While the limitations of the small study cohort are acknowledged, and a larger cohort of patients would be worth studying, it should be recognised that the high trauma caseload managed at GFJH recently rendered it suitable to be one of only two national pilot sites for the NANFISS study<sup>4</sup> referred to previously. A major reason for this is that the hospital serves a densely populated area in which more than 1 million of Cape Town's estimated 2.7 million residents<sup>10</sup> live. Most of these people have a per capita monthly income of less than ZAR300 (US\$43) and reside in suburbs with the highest firearm-related homicide rates in Cape Town.<sup>11</sup> The firearm-related injury caseload of this hospital, representing the more severe end of the spectrum in SA, means that it serves well as a site of firearm-related trauma research.

In addition to determining the cost of care, the possibility that unnecessary resources are being spent on the management of firearm-related trauma victims should also be considered. Based on the findings of this study, however, it would seem that patients are being treated in a cost-effective manner. Given the nature of the injuries sustained, neither the duration of surgery nor the length of hospital stay seems excessive. The expenditure on pharmaceuticals and blood products may seem high, but the cost of blood products has risen sharply since



comprehensive HIV screening of all blood products has been implemented. Blood, fresh-frozen plasma or platelet infusions currently cost US\$54 - 64 (ZAR378 - 448) per unit (SABTS). Laboratory and imaging study expenses were minimal in the patients studied.

The huge financial cost of providing basic in-hospital care for serious abdominal gunshot injuries raises the question of intervention, i.e. violence prevention programmes. Such programmes require accurate ongoing surveillance data. Both the fatal (NIMSS) and non-fatal injury surveillance systems (NANFISS) recently launched in SA by the Violence and Injury Surveillance Consortium have started providing insight into the extent of the problem. Similar injury surveillance mechanisms have been, and need to be, launched in other African countries where violence is perceived to be a major cause of morbidity and mortality. The systems developed in SA may serve as useful models upon which to base the design of robust data gathering tools required to properly inform intervention strategies that will stem the rising tide of violence, in particular gun violence, in SA and the rest of sub-Saharan Africa.

## Conclusion

Each surgical treatment for gunshot wounds of the abdomen costs the state health service a minimum of over ZAR10 200, a

figure 13-fold greater than the annual per capita government expenditure on health.

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