# Costing injuries in South Africa: preliminary results and challenges from a pilot study

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## SUMMARY

**South Africa has extremely high incidence rates of fatal and non-fatal injuries due to interpersonal violence, motor vehicle crashes (many involving pedestrians), burns, falls and other unintentional injuries. The direct costs associated with the medical treatment, rehabilitation and administration of these victims run into billions of Rands which could be more productively spent on primary prevention to reduce the number of new cases and improve overall life quality. Yet, the costs of injuries in the South African public health sector remain relatively unknown. To provide baseline direct medical costs for the treatment of gun shot wounds (GSWs), pedestrian-motor vehicle collision injuries (PMVCIs), falls and burns at a tertiary public health facility in Johannesburg, South Africa using adapted private health care costing procedures. Fifty-five patients were enrolled in the study, 48 of which were included in the final cost calculations. Gun Shot Wounds (GSWs) accounted for the majority (38.2%) of the injury types costed. On average, this type of injury was the most expensive to treat at ZAR6395.65 per case costed. The average treatment of PMVICs was calculated and ZAR3885.97 and the average direct cost of treating a fall was ZAR2747.83. The pilot study was complicated by the general absence of a culture of costing and a lack of general investment in the practice of injury costing itself. Further attempts to describe the costs of injuries in South Africa must address these challenges in the formative planning stages of the research. Nevertheless, despite these limitations, aggregate direct medical costs of treating these injuries reveal an immense financial burden on the public health system if extrapolated to the total incidence of injuries in South Africa. Furthermore, they support the argument for the re-direction of financial resources to primary prevention initiatives to reduce the number of new cases, improve overall life quality of populations, and minimise fiscal pressures on an already over-burdened health system in South Africa.**

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## Introduction

The release of the World Health Organisation's (WHO) Economic Dimensions of Interpersonal Violence report [1] represents a significant step in an increasing worldwide public health drive towards effectively and rigorously quantifying the economic effects of violence specifically, and injuries more generally. Unsurprisingly, the report's review of the state of interpersonal violence costing around the globe found that the majority of such documented studies have been conducted in high-income countries and that such research has been most frequently undertaken in the USA [2]. As a result, the report recommends that future research should prioritise documenting the costs of interpersonal violence in low-and middle-income countries. Recognising the importance, and given the extremely high incidence rates of fatal and non-fatal injuries due to interpersonal violence, motor vehicle crashes (many involving pedestrians),

burns, falls and other unintentional injuries in South Africa, a multi-agency group of public health researchers attempted to follow this recommendation through the implementation of a pilot injury costing study for the country.

A review of the literature indicated that research aimed at establishing the economic dimensions of injury in South Africa country is limited. However, studies in South Africa have attempted to calculate the costs of a wide spectrum of injury forms. These include national costing studies and on Motor Vehicle Collisions (MVCs) [3,4,5] and injuries from crime [6]. These national studies are supplemented by a provincial costing study of post-mortem procedures in the province of Gauteng [7] and two city-wide injury studies focused on calculating the costs of railway injury [8] and homicide for the Cape Metropole [9]. A number of small-scale, limited-sample, hospital-based cost-calculation studies constitute the remainder of the South African injury costing literature. These include the calculation of the direct medical costs of treating children involved in MVCs [ 10], burn victims [11], poison-related injuries [12] and firearm-related injury victims [13,14,15]. A summary of the items, data sources and methods used in the above studies is presented in Table 1.

**Table1.** Summary of items, sample sizes and methods used in selected injury costing studies in South Africa

| YEAR | AUTHORS | ITEM | (N) | DATA | COST TYPE | SECTOR | TOTAL |
|---|---|---|---|---|---|---|---|
| 1990 | Bass, Dickinson & Rodriquez | Motor Vehicle Collisions | 2272 | Hospital Records | Direct Medical Treatment Costs | Public | +/-R8 million |
| 1994 | De Wet, B; van Schalkwyk, D; van der Spuy, J; du Plessis, N; du Toit, N & Burns, D | Poison Treatment | 436 | Hospital Records | Direct Medical Treatment Costs | Public | R111 673 |
| 1997 | Rode, H & Quarmby, C. | Burns | 460 | Hospital Records | Direct Medical Treatment Costs | Public | R6.9 million |
| 1995 | Lerer & Matzopoulos | Railway injuries | 115 | Hospital Records | Direct Medical Treatment Costs | Public | R1.2 million |
| 1998 | Peden, M & van der Spuy, J | Gunshot Wounds | 969 | Hospital Records | Direct Medical Treatment Costs | Public | R3 858 331 |
| 1998 | Dept. of Health | Post-Mortems | n/a | Budget | Direct Medical Treatment Costs | Public | R10 543 547 |
| 1998 | Phillips, R | Homicides | 2065 | Mortuary Records | Post-Mortems Costs & Indirect Costs | Public | R90 million – R170 million |
| 1999 | Quarmby, C | Burns | 12 | Hospital Records | Medical Treatment Costs | Public | R1761 |
| 2000 | CSVR | Violence | n/a | Crime Statistics and Secondary Economic Data | Direct Medical Costs, Indirect Costs & Pain & Suffering | Public | R4.7 billion per annum |
| 2004 | CSIR | MotorVehicle Collisions | n/a | Government (StatsSA) Information and Insurance Data | Direct Medical & Indirect Costs | Public & Private | R624 405 – R898 924 per fatality |
| 2005 | Allard, D & Burch, V | Abdominal Gun Shot Wounds | 21 | Hospital Records | Direct Medical Costs | Public | R215649 |

These studies utilised one of two methodologies for calculating injury costs. The first involved the collection and analysis of various financial proxies that are not directly representative of actual injury costs. These included expenditure analysis [3], extracting and extrapolating costs from existing reports and other documentation [3,4,7] and estimating costs through activity budgets [5]. The second encompasses a range of methods that relied on the allocation of costs to cases in the form of retrospective costing using patient's records [8,10, 11,13] and cost analyses using police dockets [4].

The use of proxy cost indicators such as expenditure trends and budgets in the South African public health sector is understandable. However, providing costs based on these financial proxies is problematic because health spending is subject to a number of influences. Spending in hospitals is determined by budgetary allowances and thus may be skewed by a specific hospital's internal fund distribution policy. Even if total expenditure is broken down into specific treatment costs, these could be distorted by the location, governmental allowance (public sector) and internal policy (private sector) of that hospital [16, 17].

The same threats to accuracy hold with regards to budgets because their compilation is also influenced by many extra-economic factors (including internal policy) and these cannot therefore be regarded as unmitigated reflections of cost per se [18]. The use of budgets as an indicator for the expenses resulting from a given injury or injury cluster was found to be common within the public health sector, where individual billing is not frequently practiced. This indicator cannot be considered accurate or comprehensive as this figure (prepared at the beginning of the financial year) is an estimate of expenses and therefore cannot be broken down into more detailed and informative categories of economic costs. Budgets are also affected by a number of decisions at management level regarding internal policy and fund distribution. These internal decisions may distort or misrepresent actual injury costs. Public sector measures are thus considered adequate preliminary indicators but cannot be considered viable, comprehensive data for calculating injury costs.

Although the retrospective allocation of costs to injury cases detailed in police dockets or patient records appears a more rigorous means to establishing at least the direct costs of injury, the poor recording quality and information contained in these documents makes ascertaining such costs extremely difficult. This method is further complicated because sourcing and then allocating the stock prices and personnel costs associated with the full spectrum of health procedures typical of the treatment of severe injuries is inordinately labour intensive and expensive. This may account for the use of very limited sample sizes in the literature despite the high rate of violence and injuries in South African that imply a sizeable number of records for costing.

Perhaps a more reliable method for costing injury lies in the private sector where automated billing software and scanners keep an ongoing record of each item of stock used in the treatment of an injured patient. Personnel time is also recorded by these systems and both stock and time are automatically cross-tabulated against real costs in the generation of a bill at the time of discharge or death. Such technology is not always readily available in the South African public health sector, and despite the inclusion of profit margins that may skew real cost data, these technologies represent state-of-the-art costing methodologies in the South African health sector at present.

Clearly, measuring the costs of injury in the South African public health care sector in South Africa requires that the methodological challenges briefly outlined above must be overcome. These challenges refer to calculating the direct medical costs of injury only, and so developing a systematic and standardised method for ascertaining this category of costs must surely precede any attempt at describing the other more difficult indirect and human value costs resulting from violence and injury. Such expertise is unquestionably located in the private health sector in South Africa, where accurate cost and billing information had been prioritised under state-of-the-art billing systems for well over two decades. This indicated the necessity of a public-private sector partnership to explore the feasibility of developing a systematic and standardised method aimed at calculating the costs of injury in South Africa. In light of the above challenges a pilot injury costing study was conceptualised to provide baseline direct medical costs for the treatment of selected injury types by adapting some of the well-established costing capacities of the private health sector to a public health environment. Johannesburg General Hospital, a 1088 bed tertiary and teaching hospital situated in the province of Gauteng South Africa, was the public health setting selected for the study.

The study aimed to make use of the costing expertise and procedures used in the South African private health care sector to provide an estimate of baseline direct medical costs for the treatment of gun shot wounds

(GSWs), pedestrian-motor vehicle collision injuries (PMVCIs), falls and burns at a tertiary public health facility in Johannesburg, Gauteng. This province has been estimated to have the highest average annual trauma caseload of all South African provinces with 11 023 cases or 30 trauma admissions per day [ 9].

## Material and Methods

The study used a prospective costing design with patients presenting to the trauma wards with the selected injury types being charged according to charging sheets and procedures developed in the private sector, that were adapted for public sector use. Charging continued through the treatment of each selected patient until discharge or death. GSWs, PMVCIs, falls and burns were targeted for collection. Justification for inclusion of these injury types was provided by the National Injury Mortality Surveillance System (NIMSS) which recorded approximately 35% of all non-natural deaths in South Africa for the year 2002 [ 0]. The system however commanded full coverage of the 4264 recorded deaths in Johannesburg for that year. GSWs (36.3%), PMVCIs (12.2%), burns (4.9%) and falls (2.5%) together accounted for 56% of all deaths in the city in 2002. Moreover, inclusion of these injury types implied that all conventional categories of non-natural death, namely intentional, transport-related and unintentional manners of death were represented in the study.

The study aimed to track all patients that entered at each point of care anticipated by the trauma entry and management process. These included the emergency room, theatre, intensive care and general ward components. In collaboration with a major private health care provider, selected nursing staff within these units were trained to collect data according to the modified protocol. All used consumables were discarded into large plastic bags, and then counted and costed. Personnel costs were not included in the study.

***Patient inclusion criteria***

All patients, 18 years of age or over for GSWs, PMVCIs and falls and patients under 16 years of age for burns admitted to the Johannesburg Hospital for the period January to May 2004 were eligible for inclusion in the study. The nature of the pilot study implied an inclusive patient admission policy. Variables such as injury severity and nature of transportation to hospital did not feature in the inclusion criteria of thissampling set but would need to be included in future research. The pilot/study system was implemented in January 2004 after ethical clearance and administrative permission was obtained from the directorship of the Johannesburg General Hospital.

## Results

***Sample characteristics***

A total of 55 patients were enrolled in the study. Age was unknown in 35(62.5%) of cases. The age of the remaining recorded ages ranged from 21 to 63 years with a mean age of 33.05 (S.D. 10.73). The number of cases captured in each of the prescribed injury types is described in Table 2 below.

**Table 2:** Injury type by number of cases (n=55)

| Injury Type | Number of Cases | Percentage of Cases |
|---|---|---|
| Burns | 1 | 1.8 |
| Fall | 12 | 21.8 |
| GSW | 21 | 38.2 |
| PMVCI | 14 | 25.5 |
| Unknown | 7 | 12.7 |

Seven cases of injury were costed where the specific injury type could not be established. These 7 unknown injury types were excluded from all subsequent analyses and injury cost-calculations. The aggregated total direct medical costs of treating 48 cases in both the ICU and 163 (trauma) wards are summarised in

**Table 3.** Aggregated direct medical costs by injury type (n=48)

| Injury Type | Number of Cases | ICU | Ward 163 | Total |
|---|---|---|---|---|
| Fall | 12 | 19788.76 | 13185.21 | 32973.97 |
| GSW | 21 | 114765.07 | 19543.62 | 134308.69 |
| PMVCI | 14 | 47572.48 | 6831.10 | 54403.58 |
| Burn | 1 | 372.08 | 12.05 | 384.13 |
| **Total** | **48** | **182498.39** | **39571.98** | **222070.37** |

the Table 3 above. These costs exclude bed costs and personnel hours, and reflect consumables only.

Table 3 indicates that the cost of treating GSWs was the highest of the four injury types. The single case of burns was excluded from the following calculation of average treatment costs (Table 4) as it could not be utilised to generate an average cost for the treatment of burns. The average direct costs of treating 47 cases in both the ICU and WARD 163 (trauma) wards are summarised in the Table 4 below. These costs exclude bed costs and personnel hours once more. Again GSWs were the most expensive injury type to treat on average.

The direct medical treatment costs of 48 (including a single burn case), meeting the selection criteria outlined above, presenting at the Johannesburg hospital for a 5 month period beginning in January 2004 was ZAR 222070.37.

The nature of the convenience sample, quality of data collected and lack of receptivity to the costing system at the hospital all posed obstacles to the effective operationalisation of the study. In addition, the urgency of the needs of unstable patients at times complicated the collection and therefore the cost-calculation of consumables.

**Table 4:** Average direct medical costs by injury type (n=47)

| Injury Type | Number of Cases | ICU | Ward 163 | Total |
|---|---|---|---|---|
| Fall | 12 | 1649.06 | 1098.77 | 2747.83 |
| GSW | 21 | 5465.00 | 930.65 | 6395.65 |
| PMVCI | 14 | 3398.03 | 487.94 | 3885.97 |

## Discussion

While these obstacles severely limited the quality of information produced by the present study, careful scrutiny of their forms and causes serves to illustrate the broader constraints of developing an injury costing system in South Africa.

***Complex mechanisms of Injury***

A number of patients were admitted for GSWs and falls as well as other combinations of injury. In these cases, a complete costing profile of the injury was difficult to calculate. Dual mechanisms of injury created difficulties for the costing system, and this was further compounded by the absence of injury severity scores within the inclusion-exclusion protocols. Multiple or dual injuries quite obviously escalate treatment costs. The pilot system was not however equipped to distinguish discrete treatment costs for those patients that incurred dual injuries (for example, from both a GSW and a fall). In these cases, the primary temporal mechanism of injury was selected for immediate cost-calculation according to the protocol of the system.

***Patient capture and follow-up difficulties***

As is the case with many African tertiary hospitals, the Johannesburg Hospital policy prescribes that due to a shortage of tertiary beds, patients must be actively decanted to the most appropriate levels of care, often outside of the institution. This resulted in many of the post-stabilisation costs of injuries incurred by preliminarily enrolled patients eluding the pilot system cost calculation protocol. This limitation was most pronounced in attempting to enroll burn patients in the study. The Johannesburg General Hospital does not provide a stand-alone burns unit; it was therefore difficult to enter sufficient numbers of burn patients into the system. Additionally, current South African public sector hospital protocols demand pre-hospital triage. In most cases low-priority burn patients were triaged to other more appropriate centres. This made it difficult to capture the vast numbers of burn patients that were admitted to neighbouring facilities. Future studies should therefore include decanting destinations to more accurately establish trauma-related injury costs.

***Elusive cost items***

The costing of several items was not adequately accommodated by the system. The most obvious example was oxygen, a sine qua non of trauma treatment. In addition, several items were not consistently costed at the same rate; these included all types of intravenous fluids.

***No culture of costing***

The absence of an established culture of itemised billing and rigorous costing for individual patients provided the greatest obstacle to the study. In an already under-resourced South African public health system, additional data collection protocols are seen as burdensome and time consuming. The very utility of gleaning cost of injury information needs to be more forcefully embedded in the everyday practices of the

public health system. A macro-system approach to injury costing is thus required to encourage receptivity to measuring injury costs on the ground. The micro-transfer of costing skills is not sufficient to incentivise health personnel to accommodate the requisite costing techniques and systems into their everyday job descriptions. Such a macro-oriented approach will require protocol changes in costing and billing that are infused into everyday practices, education of staff, genuine skill transfers and information dissemination initiatives. These could include public-private goal-oriented partnerships aimed at the national rollout of a public health costing system, and cross-sectoral collaborations that stress the successes of economically quantifying health burdens. Such successes have been numerous in the South African HIV/Aids prevention sector [21] where the calculation of baseline societal costs and subsequent illustrations of prevention and treatment benefits have been strategically employed to leverage support for prevention initiatives and advocate and lobby for better quality and access to health-related information, prophylaxis and anti-retrovirals.

## Conclusion

Despite its relatively low data yield, this study represents another step towards stimulating multi-sectoral interest in the development of a costing system for installation in the public health sector in South Africa, and may also highlight lessons and challenges for public health sectors in other African contexts where similar strategies are being considered.

Extrapolating even these limited cost estimates of direct medical treatment to the fatal as well as the even larger non-fatal injury burden in South Africa, exposes the immense financial drain on the current public health system. This is valuable not only for health planning and management, but also for health practitioners wishing to promote the redirection of fiscal resources towards prevention efforts. Certainly, a pressing challenge to the development of a public health sector injury costing system is the development of a culture of costing. Once such a culture has been established, the system-specific challenges of installing a national injury costing system may be more fully addressed.

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