SAJS
Trauma

The epidemiology and cost of trauma to the orthopaedic department at a secondary-level hospital

E. E. LUTGE, M.B. CH.B., M.P.H., F.C.P.H.M.
Department of Community Health, Nelson R. Mandela School of Medicine, University of KwaZulu-Natal, Durban

D. MUIRHEAD, B.SC., M.SC., GRAD.DIP.ECON. (MONASH)
Centre for Health Policy, University of the Witwatersrand, Johannesburg

Trauma in South Africa is indeed a 'malignant epidemic'*.[1] Approximately 70 000 South Africans die every year, and a further 3.5 million seek care at health care facilities, as a result of trauma.[2] From 1990 to 2020 there is likely to be a significant increase in the injury-related burden of disease in sub-Saharan Africa unless effective prevention measures are put in place.[3] Approximately 9 000 people are killed on South Africa's roads every year, and 33 000 seriously injured.[2] Our road traffic death rate of 11.7 per 100 million kilometres travelled ranks in the top 10 in the world.[4] Nationally, 39% of those killed on the road are pedestrians, although this figure has decreased from 47% in 1987.[2]

This study attempted to outline the epidemiological pattern of trauma and the costs of this trauma over a year in the orthopaedic department at a single secondary-level urban hospital in Durban. For the purposes of this study, trauma was defined as injury arising from assault, gunshot or motor vehicle accidents (MVAs).

Patients and methods

This was a retrospective record review conducted at a secondary-level training hospital in Durban which provides specialist orthopaedic care to clinics and district hospitals. The study period was 1 January - 31 December 2000.

The financial costing of inpatient care was done from the perspective of the hospital. Any costs faced by the patient (such as transport costs) or by wider society (such as productivity losses due to injury) were therefore outside the scope of this study. Cost analysis was done for the inpatient treatment of victims of MVAs, gunshots and assaults in the orthopaedic ward and theatre only. Costs of treatment before admission (such as in the trauma unit), any treatment in the intensive care unit (ICU), and treatment after discharge (such as in the outpatient unit) were not included in this study. Costs from the 2001/2002 financial year were used to prevent inaccuracies as a result of inflation and cost increases. Two costing methods were used in this study, viz. the bottom-up (ideal) and top-down methods. The results of the top-down method were compared with those of the bottom-up method to assess whether the former is sufficiently accurate to be used as a management tool.

Costs for ankle, elbow, foot, femur, hand, humerus, radius/ulna and tibia/fibula injuries were ultimately calculated as hip, knee and shoulder injuries (each comprising 2% or less of all trauma seen on the orthopaedic ward) and were excluded from the analysis. The profile of a 'typical case' in each diagnostic category was created and costed.[5] The costs for all the patients in each category were then added to get a total cost of care. This was done using both the bottom-up down methods.

Formulae

Bottom-up method: Costs of staff time (theatre and ward) + costs of drugs + costs of laboratory tests + costs of X-rays + costs of consumables (theatre and ward) + costs of prosthesis + overhead costs.

Top-down method (daily cost): Total expenditure (hospital)/(total inpatient days + 1/3 outpatient visits). This is the standard formula used in South Africa.

Results

Epidemiology of trauma

Assault, gunshot and MVA injuries accounted for 62.91% of a total of approximately 850 orthopaedic operations performed at this hospital during 2000. MVAs accounted for 35.76% of orthopaedic operations during that year, more than assaults and gunshots combined. Within this category, the person most commonly injured was the pedestrian, accounting for almost half (46.30%) of all MVA injuries (Fig. 1). The person next most commonly injured was the passenger, accounting for 29.63% of all MVA injuries. Drivers were relatively infrequently admitted for surgery, accounting for only 11.11% of all MVA injuries. Where the role of the patient in the MVA (that is, pedestrian, passenger or driver) was not specified, this was coded simply as MVA. This category accounted for 12.96% of all MVA injuries.

Gunshots accounted for 14.56% of all orthopaedic surgery performed during that year, and assaults for 12.59%.

Most (73.58%) of those injured in MVAs were men. For gunshots and assault the preponderance of men was greater

*This term is defined in Muckart's article[1] as 'a widely diffuse and rapidly spreading condition affecting many people in any one region at the same time and tending to become progressively worse and to result in death.'

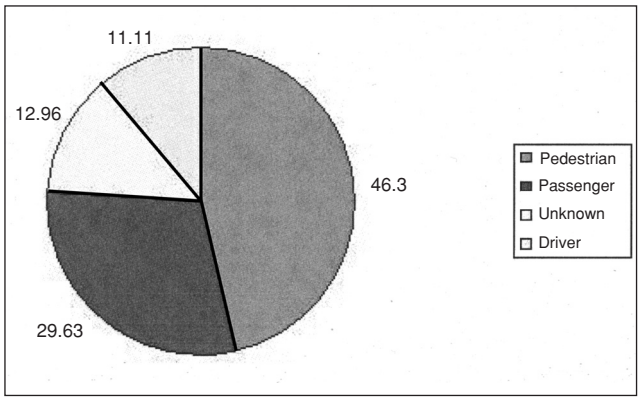

Fig. 1. Persons injured in MVAs.

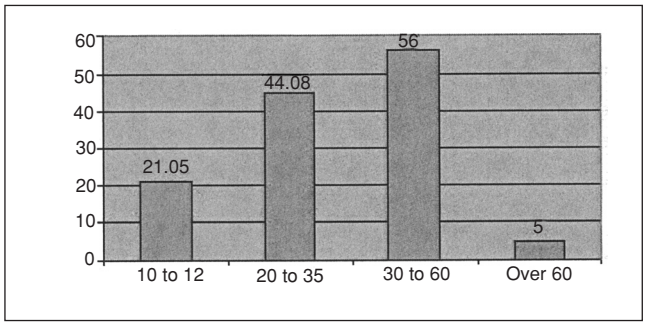

Fig. 2. Proportion of all operations performed on assault and gunshot-injury patients, per age group.

(91.30% and 76.47% of the total samples respectively). For trauma involving intentional interpersonal violence, the vast majority of victims in the sample were black. Most patients who had surgery for assault and gunshots (73.68% and 78.26% respectively) were black. This pattern was similar for pedestrians injured in MVAs, where 76.00% were black. However the racial pattern was different for other types of injury due to MVAs. Most drivers in the sample were Asian (66.67%), and of the passengers injured in MVAs, 50.00% were black and 37.50% were Asian.

The contribution of trauma to the total patient load in each age group decreased with age. In the 10 - 19-year age group, 94.38% of all operations were on patients with assault, gunshot and MVA injuries. In the 20 - 35-year age group, this proportion decreased to 75.71% and in the 36 - 60-year age group, to 62.50%; in both cases this was because of a decrease in the number of MVA injuries. However, the relative proportions of gunshots and assaults increased with each age group (Fig. 2). In people over 60 years, trauma only accounted for 5% of all orthopaedic operations performed and was solely as a result of gunshots. Falls (not defined as trauma for the purposes of this study) accounted for 90% of all operations performed in this age group.

Costing study

Cost of trauma

The total cost of assault, gunshot and MVA injuries to the orthopaedic ward for the year 2000 was found to be R5 440 964.20, using the bottom-up method. Using the top-down method, this cost was R5 847 882.20.

Fractured femurs accounted for the large majority (63.62%) of hospital costs resulting from assaults, gunshots and MVAs. This was not so much because the unit costs (unit cost refers to the cost of care for a single patient) for fractured femur were the highest in this study (Table I); rather it was because the latter constituted by far the largest number of trauma injuries admitted to the orthopaedic ward in 2000.

Table I shows the unit costs for each category of injury, as well as the total costs of these trauma injuries, using the bottom-up method.

Comparison of costing methods

The unit costs for most of the injury categories calculated using the top-down method were within 20% of the costs calculated using the bottom-up method. For example, the unit cost for a fractured femur calculated using the top-down method (R13 253.31) closely approximated that using the bottom-up method (R12 637.25). Only two categories of injury fell outside this range, viz. injuries to the foot and to the radius/ulna. The deviation in these two categories was probably due to chance, since treatment for the latter two categories of injury was not systematically different in any way from treatment for injuries where the costs of the two methods approximated each other more closely.

Table I. Costs of hospital treatment for each pathological category of trauma injury in 2000, using the bottom-up method (in South African rands)

Site of injury	Number due to trauma	Unit costs* (including internal fixation)	Total costs due to trauma
Ankle	**30**	**10 803.79**	**324 113.70**
Elbow	**24**	**4 553.48**	**109 283.52**
Femur	**253**	**12 637.25 (average cost)**	**3 197 224.30**
Foot (including toes)	**24**	**8 167.91**	**196 029.84**
Hand (including fingers and thumb)	**24**	**3 925.78**	**942 18.72**
Humerus	**48**	**11 869.38**	**569 730.24**
Radius/ulna	**78**	**6 799.06**	**530 326.68**
Tibia/fibula	**36**	**11 667.70**	**420 037.20**
Total	**517**		**5 440 964.20**

* Costs were taken from the 2001/2002 financial year.

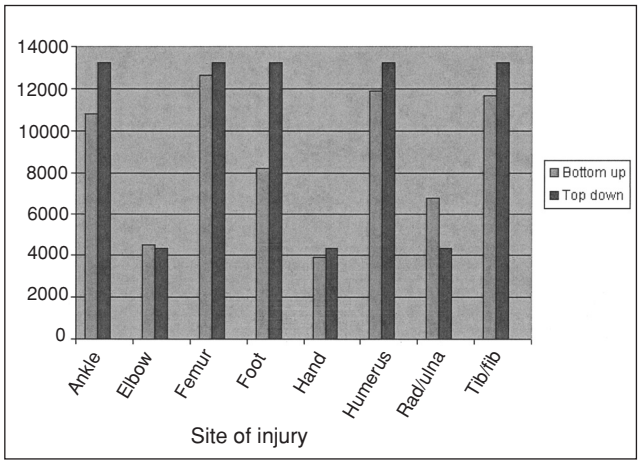

Fig. 3. Unit costs using the bottom-up and top-down methods.

Discussion

Epidemiology of trauma

In many ways the pattern of trauma revealed in the analysis of patients undergoing orthopaedic surgery during 2000 reflects that in other parts of South Africa.[2]

Trauma (defined here as MVA, assault and gunshot injuries) accounted for almost 63% of all orthopaedic operations done at the study hospital during 2000. Any health problem that so dominates a health institution demands intense and urgent enquiry and action. The fact that the response to the modern trauma epidemic has been disproportionately small[6] means that the tragedy of avoidable deaths and disability is likely to continue, and even to increase in the future.[3]

The proportion of surgical procedures necessitated by trauma in this study mirrors that found elsewhere in Durban. In 1988, 60% of emergency admissions to the general surgical ward at King Edward VIII Hospital in Durban were trauma-related.[1] In 1992, 66% of all admissions to the ICU, and 14.4% of all hospital admissions at the same hospital, were due to gunshot injuries.[7] In an analysis of the non-natural causes of death at certain South African mortuaries, the national Non-natural Mortality Surveillance System (NMSS) found that 72.8% of all non-natural deaths resulted from homicide or MVAs.[8] This is comparable to the present study's definition of trauma as including gunshot, assault and MVA injuries; the proportion found to be trauma-related in the NMSS report is probably only higher because the sample was drawn from all non-natural deaths (as opposed to all surgical procedures, which includes a number of operations for benign conditions).

The pattern of MVA injuries is reflected in the findings of the NMSS, where 41.9% of people who died in traffic accidents were pedestrians, 14.6% were passengers and 13.1% were drivers.[8] The discrepancies are again perhaps due to the fact that the NMSS only collects information on people who have died in accidents, whereas this study looked only at people who reached hospital alive and who survived to undergo surgery for their injuries. In addition, both this study and the NMSS are constrained by paucity of data – the traffic-user category was not specified in 12.96% of MVA injuries in this study and almost one-third of MVA injuries in the NMSS. This large pool of unspecified data may well contribute to the discrepancies between this study and the NMSS.

Just over 73% of all MVA injuries were sustained by men. Approximately 70% of pedestrians, 68.75% of passengers and 100% of drivers in this study were men. This is comparable with figures from the NMSS, which were 72.5%, 63.9% and 86.7% respectively. It has been shown that men are more likely to take risks and to demonstrate aggressive behaviour than women, which would account for their predominance in this category of trauma victims.[9]

A high proportion of all orthopaedic operations in 2000 were the result of interpersonal violence – either gunshots (14.56%) or assault (12.59%). The figure for gunshots is almost identical to figures from an inner-city trauma centre in the USA.[10] The NMSS confirmed the finding that in Durban guns are more frequently used as weapons of assault than other instruments.[11] In addition, this surveillance system found that in Durban sharp instruments are more commonly used for assault than blunt instruments, but our study did not investigate this aspect of assault.

Men were far more likely to be shot than women. The strong association between gender and cause of death was confirmed by Bradshaw *et al*.[12] In an analysis of non-natural deaths in 1996 the latter found that the major cause of injury death among men was homicide, while for women it was unintentional injury. The present study found that 91.30% of all gunshot injuries in 2000 were sustained by men. This percentage is comparable with figures from Cape Town,[13] nationally,[11] and in certain countries around the world.[10,14,15] The figures are similar for assault, with 76.47% of all injuries due to assault being sustained by men. This is probably because men are more likely than women to engage in physical violence,[16] and are also more likely to abuse substances such as alcohol which are associated with an increased propensity for violence.[16,17] The reasons for this are complex and difficult to address. The recent Firearms Control Act (Act 60 of 2000) is probably the most promising attempt in the short term to decrease gunshot injury mortality. However, efforts to decrease interpersonal violence in South African society in the long term will require much more complex and wide-ranging interventions.

Most people injured as a result of interpersonal violence were black, with 78.26% of gunshot victims and 73.68% of victims of assault being black. Although blacks constituted a large percentage of the total patient population in the year 2000, this was not quite a majority (49.45%), and therefore the percentage injured by interpersonal violence is still disproportionately large. Similar figures are also evident in the USA,[10] and again the reasons are complex. Although our stricter gun control laws are probably the most effective remedy for unnecessary suffering and loss of life in the short term, long-term remedies will require massive social reorganisation.

The fact that almost 63% of all orthopaedic operations performed during the year 2000 were for assaults, gunshots or MVAs means that trainee health professionals, particularly registrars, are restricted in their exposure to pathologies other than those caused by trauma. This may have a negative impact on their learning experience, and undermine their competence in dealing with pathologies of different aetiologies.

Cost of trauma

The total cost of trauma to the orthopaedic ward for the year 2000, using the bottom-up method which is generally thought to be superior,[18] was calculated to be R5 440 964. This was more than the total annual expenditure of the hospital on maintenance (R4 792 879 in the 2001/2002 financial year) and far exceeded hospital expenditure on administration (R2 343 799) and equipment (R1 682 024) for the same year. It constituted almost 2% (1.96%) of total hospital expenditure, using 2001/2002 expenditure data. Taking into account that this was only for one discipline within the hospital, and that it excluded ICU, outpatient and trauma unit costs, the impact of assaults, gunshots and MVAs on this hospital's budget was significant.

Of the total of R5 440 964, 63.62% was a result of fractured femurs. In this study, as in another,[19] the most common fracture site was the lower extremities. The unit cost of a fractured femur, calculated using the bottom-up method, was R12 637 (average cost including internal fixation) or R9 608 (excluding internal fixation). Close approximation of the costs calculated using the bottom-up and top-down methods means that the more convenient top-down method is sufficiently accurate to be used as a tool by management.

Limitations of the study

This study included only patients who had been operated on. Patients managed conservatively, that is without surgical intervention, were excluded. Although it has been shown that the majority of orthopaedic injuries require surgery,[20] some important categories of injury may have been excluded. The most important of these is spinal injuries, which require intensive and long-term treatment in the orthopaedic ward. This may have affected the epidemiological pattern of trauma and would have affected the trauma costs calculated in this study. Also, only single injuries were costed. A certain percentage of trauma patients present with multiple injuries which are more expensive to treat. This focus on single injuries will have underestimated the total burden of trauma to the orthopaedic ward and the costs involved in the treatment of patients in the ward.

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