

Financial Cost of Treating Polytrauma in a Public Tertiary Hospital in the South-Eastern Democratic Republic of Congo: A Case Series Study

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Context: Polytrauma constitutes a major public health issue that is steadily increasing. In developing countries, including the Democratic Republic of Congo, this phenomenon is exacerbated by a combination of factors, such as inadequate funding mechanisms, the high cost of healthcare services and the low socio-economic level of the populations at risk. This study aims to assess the financial cost of treating polytrauma in a tertiary hospital in the Democratic Republic of the Congo.

Patients and Methods: A case series study was conducted at the Jason SENDWE provincial referral general hospital in Lubumbashi, with data collected from 1 January to 31 December 2023. The study was based on the operational definitions of Heinrich and the economic burden of care at the individual level was calculated by dividing the average direct costs by the GDP per capita, PPP of the country.

Results: The present study comprised forty patients with polytrauma, with a mean age of 29.73 ± 9.9 years, ranging from 9 to 45 years. Approximately 65% of cases were attributed to road accidents, with a male predominance of 82.5%. The most frequently observed form of vital distress was neurological, accounting for 60% of cases, and le parage chirurgical comme acte chirurgical (28.11%). The overall survival rate was 7.50%, with a mean direct cost per patient of USD 608.77 ± 370.85 (range: USD 139.78 to USD 1826.34). This equates to a financial burden of $93.79 \pm 57.13\%$ of GDP per capita, ranging from 21.54 to 281.36% of GDP per capita. The proportion of out-of-pocket payments was 97.5%. The highest proportion of expenditure (42.2%) was attributed to medications, followed by the cost of surgical procedures (23.21%), and then imaging examinations (19.8%). Conversely, the lowest expenditure was observed to be related to resuscitation (1.21%) and laboratory tests (1.83%). It was observed that only polytrauma patients admitted to intensive care and hospitalised for 43 days or more exhibited a higher mean direct cost, with statistically significant differences (at a risk of 5%).

Conclusion: Patients with polytrauma are at significant risk of incurring catastrophic health expenditures. The results provide insight into the financial implications of polytrauma, which may inform the organisation of trauma care.

Keywords: polytrauma, cost-minimization analyses, management

Introduction

Polytrauma represents a significant global health concern, identified by the World Health Organization (WHO) as a major challenge in future healthcare.¹ Despite advancements in its management, polytrauma continues to be a leading cause of death and disability worldwide.²⁻⁴

The number of polytrauma patients is relatively low in comparison to the total number of hospitalised patients; however, their impact on health services is significant.⁵ For example, in France, polytrauma constituted 10% of all trauma

patients in Belfort,⁶ 3 million admissions of polytrauma patients to intensive care in 2015 in the United States,⁷ and a frequency of 17.95% of polytrauma at the University Hospital of Parakou in Benin.⁸

The management of polytrauma is a complex process. The typical management plan for polytrauma patients includes resuscitation, emergency surgery, intensive care, and complex reconstructive surgery.⁹ The convalescence period, rehabilitation, and hospitalisation are frequently protracted.⁹ This suggests that polytrauma patients are at an elevated risk of mortality compared to what would be expected based on the mortality rates associated with their individual injuries. In the Democratic Republic of Congo (DRC), the overall mortality rate of polytrauma patients declined from 90.7% in 2014 to 70% in 2017.¹⁰ Furthermore, polytrauma is associated with significant social and economic implications for both the patient and society at large.⁹

There is compelling evidence that patients with complex polytrauma are better managed in tertiary-level care settings.^{11,12} Despite the integral role of trauma services in emergency care in these settings, the lack of information on the costs of patient care may present a barrier to the financial accessibility of trauma care in the context of the country's initial efforts towards implementing universal health coverage (UHC). It is evident from statistical data that the financial outlay on healthcare in acute and emergency care settings is significantly higher in cases of polytrauma.¹³

The aim of this study is to assess the financial implications of trauma management in a provincial general reference hospital in the Democratic Republic of the Congo (DRC) and the associated clinical factors. Furthermore, in developing countries such as the DRC, the management of multiple trauma is constrained by inadequate financial resources, the high cost of services, the absence of pre-hospital medicine and the low socio-economic status of the affected populations.¹⁴

Materials and Methods

Scope and Type of Study

A case series study was conducted to evaluate the economic aspects of the management of multiple trauma at the Jason SENDWE Provincial General Reference Hospital in Lubumbashi. The study period was from 1 January to 31 December 2023 and focused on data collected during that time. The study will be conducted at the HGPR Jason SENDWE, located in Lubumbashi, in the Democratic Republic of Congo. The HGPR Jason Sendwe is situated in the eastern part of the Lubumbashi commune, in the city's health zone. Its geographical location is delineated by the following boundaries: Avenue Sendwe to the north, Avenue des Écoles to the south, Lycée Wema to the east, and Avenue Likasi to the west. This public health establishment comprises two primary sections: a pavilion area and a multi-storey area housing various medical services.

Participants

The present study encompassed all patients presenting with multiple trauma and undergoing treatment during the specified period. The prevailing definition of a polytrauma patient is an individual sustaining two or more injuries, at least one of which is deemed to be life-threatening.¹

Sampling and Sample Size Calculation

Exhaustive sampling was employed, which facilitated the inclusion of 40 polytrauma patients.

Inclusion Criteria

All patients admitted with polytrauma between 01 January and 31 January 2023 were to be included.

Exclusion Criteria

Patients with polytrauma admitted between 01 January and 31 December 2023 and admitted for other traumas but who do not meet the criteria for polytrauma patients.

Data Sources and Variables

The data were collated using a documentary data extraction sheet. A questionnaire was developed which integrated social, clinical and economic factors related to the disease. Administrative data were collected, and sociodemographic and clinical data were gathered through a documentary review of consultation sheets and registers.

The following variables were collected: age, sex, municipality of residence, mechanism of trauma, means of transport from the site of trauma to the hospital, diagnosed vital distress, insurance status, imaging tests performed, drugs used, surgical procedures performed, biological tests performed, date of admission and date of discharge, and method of payment of medical expenses.

The study was based on the operational definitions of direct costs (DC) as defined by Heinrich^{15–17} and developed by^{18,19} in studies on the economic and financial evaluation of cancer care in our environment. DCs are defined as current financial burdens attributable to disease acts, including hospitalisation costs, medical care and laboratory costs. The following items were included in the calculation of direct costs: the cost of surgical procedures, the cost of nursing procedures and medical visits, the cost of medications (including oxygen), the cost of imaging, the cost of biological tests, the cost of intensive care, and the cost of hospitalization.

Furthermore, the economic burden of polytrauma care at the individual level was calculated by dividing the average direct costs by the country's GDP per capita, PPP. This measure indicates the potential catastrophic impact of these costs on the average citizen, as represented by the GDP per capita.²⁰ The gross domestic product (GDP) per capita, based on purchasing power parity (PPP), represents the total value of goods and services produced within a country, converted to international dollars using purchasing power parity rates. The calculation does not include any deductions for depreciation of manufactured goods or depletion and degradation of natural resources. The data are presented in constant 2023 international dollars.²¹

Statistical Methods

The data were encoded and analysed using Epi Info 7.2.6.0 (CDC, USA) and Microsoft Excel 2016 (Microsoft, USA). The statistical and epidemiological analyses comprised the calculation of proportions and figures for qualitative variables, and parameters of central tendency (mean, median, P25 and P75) and dispersion (standard deviation) for quantitative variables. Furthermore, Student's t-test was utilised to compare the means of direct costs according to socio-demographic and clinical parameters in polytrauma patients. The threshold of statistical significance was set at $p < 0.05$.

Ethical Considerations

A research certificate has been obtained (reference number 0040/2024). The study was conducted in accordance with the ethical standards set forth by the Faculty of Medicine of the University of Lubumbashi (UNILU). All data were collected with strict respect for anonymity and confidentiality.

Results

The study population comprised a total of 40 polytrauma patients. The results pertaining to the sociodemographic characteristics of polytrauma patients are presented in Table 1. The majority of participants were from the city of Lubumbashi (87.5%), while only 12.5% were from outside the city. The male sex was the most predominant, representing 82.5% of the sample, with a mean age of 29.73 ± 9.9 years, ranging from 9 to 45 years. The age group most affected by polytrauma was that of 19 to 28 years (40%). The majority of cases (65%) were due to road traffic accidents, while 12.5% were the result of assaults. The majority of patients (97.5%) paid for their treatment out of pocket.

Table 2 presents the clinical characteristics of polytrauma patients. Of the patients, 60% exhibited neurological vital distress, the median total hospital stay was 27.8 days (interquartile range: 14.25–42.5), and 37.5% of patients had remained in hospital for a duration of 1–10 days. The mean duration of intensive care was 3.9 ± 3.2 days. The mean duration of hospitalisation was 23.8 ± 41.8 days, with the majority of patients (57.5%) remaining in hospital for a period of 1 to 10 days. Surgical trimming was performed in 28.11% of cases. The survival rate was 7.50%.

Table 3 presents an overview of the direct costs associated with polytrauma management. The mean total direct cost was 608.77 ± 370.85 USD. The minimum and maximum costs were 139.78 USD and 1826.34 USD, respectively, representing a burden of 52.02% of GDP per capita per year.

Table 4 presents the results of the comparison of the mean direct costs of polytrauma care in relation to socio-demographic and clinical parameters. It was observed that the average direct cost is higher only when polytrauma patients were admitted to intensive care (693.64 ± 352.51 USD against 208.66 ± 69.60 USD for polytrauma patients not

Table I Parameters Sociodemographic, Mechanism of Occurrence

Variables	n=40 (%)
Origin	
Out of town of Lubumbashi	5 (12.50)
Lubumbashi	35 (87.50)
Sex	
Female	7 (17.50)
Male	33 (82.50)
Age group (year)	
Avg.±SD (Min-Max)	29.73 ± 9.9 (9–45)
9–18	4 (10)
19–28	16 (40)
29–38	10 (25)
39–45	10 (25)
Mechanism of occurrence	
Assault	5 (12.50)
Firearm	2 (5.00)
Bladed weapon	1 (2.25)
Road traffic accident	26 (65.00)
Fall	4 (10.00)
Collapse	1 (2.50)
Others	1 (2.50)
Payment method	
Out-pocket	39 (97.50)
Prodeo	1 (2.50)
Routing to hospital	
Unknown	8 (20.00)
Police jeep	2 (5.00)
Motorbike	7 (17.50)
Taxi/bus	22 (55.00)
Private vehicle	1 (2.50)

admitted to intensive care). Furthermore, statistically significant differences were observed between the two means (at 5% risk) for polytrauma patients not admitted to intensive care and those hospitalised for 43 days or more (1009.71 ±475.02 USD against 508.53±264.98 USD).

Table 2 Clinical Characteristics of Polytrauma Patients

Variables	n=40 (%)
Vital distress	
Circulatory	8 (20)
Circulatory and neurological	4 (10)
Circulatory and respiratory	1 (2.50)
Neurological	24 (60.00)
Respiratory	2 (5.00)
Respiratory and neurological	1 (2.5)
Total length of hospital stay (days)	
Mean $\pm$ standard deviation (minimum-maximum)	27.8 $\pm$ 42.5 (1–247)
1–10	15 (37.5)
11–20	12 (30)
21–247	13 (32.5)
Number of days spent in intensive care (days)	
Mean $\pm$ standard deviation (minimum-maximum)	3.9 $\pm$ 3.2 (0–17)
0–3	16 (40.00)
4–7	21 (52.5)
8–19	3 (7.5)
Length of hospitalization in room (days)	
Mean $\pm$ standard deviation (minimum-maximum)	23.8 $\pm$ 41.8 (0–243)
0–10	23 (57.5)
11–21	7 (17.5)
33–43	2 (5.00)
44–54	4 (10.00)
55–243	4 (10.00)
Acts surgical	
Amputation	1 (2.56)
None	16 (41.03)
Pleural drainage	1 (2.56)
Laparotomy	1 (2.56)
Laparotomy, surgical debridement, plastering	1 (2.56)
Laparotomy, revision for laparorrhaphy	1 (2.56)
Osteosynthesis, pleural drainage	1 (2.56)
Osteosynthesis, surgical debridement	3 (7.50)

(Continued)

Table 2 (Continued).

Variables	n=40 (%)
Osteosynthesis, surgical debridement, plastering	1 (2.56)
Osteosynthesis, plastering	2 (5.13)
Surgical debridement	11 (28.21)
Trepanation	1 (2.56)
Survival	
No	3 (7.50)
Yes	37 (92.50)

Table 3 Direct Costs and Burden of Polytrauma Management

Cost Component	Total Cost	Mean $\pm$ Standard Deviation	Minimum	Maximum
Drugs	10275.94	256.90 $\pm$ 129.63	29.58	654.52
Acts surgical	5650.91	141.27 $\pm$ 241.32	0.00	1050.70
Biology	445.41	11.14 $\pm$ 9.55	3.52	65.14
Imaging exam	4820.48	120.51 $\pm$ 64.87	21.13	280.19
Stay in intensive care	294.01	7.35 $\pm$ 6.71	0.00	36.97
Hospitalization	1008.98	25.22 $\pm$ 44.36	0.00	256.68
Acts nurses and visits medical	1855.05	46.38 $\pm$ 51.36	5.46	295.77
Total	24350.78	608.77 $\pm$ 370.85	139.78	1826.34
%GDP per capita		93.79 $\pm$ 57.13	21.54	281.36

Table 4 Presents a Comparison of the Mean Direct Costs of Polytrauma Care According to Socio-Demographic and Clinical Parameters

Settings	n=40	Mean $\pm$ Standard Deviation	t(obs)	ddl	p
Sex					
F	7	725.77 $\pm$ 428.26	-7.78	38	0.44
M	33	899.49 $\pm$ 549.35			
Age group (years)					
< 18	4	921.54 $\pm$ 660.23	-0.206	38	0.837
18–45	36	863.26 $\pm$ 524.04			
Distress vital					
With damage neurological	29	809.23 $\pm$ 529.94	-1167	38	0.25
Without reaching neurological	11	1026.91 $\pm$ 518.69			

(Continued)

Table 4 (Continued).

Settings	n=40	Mean $\pm$ Standard Deviation	t(obs)	ddl	p
Stay in resuscitation					
Yes	33	990.25 $\pm$ 503.24	-3.59	38	0.0009*
No	7	297.88 $\pm$ 99.37			
Duration hospitalization (days)					
1–42	32	725.99 $\pm$ 378.29	-4.03	38	0.0003*
43 and over	8	1441.48 $\pm$ 678.15			
Mechanism of occurrence					
Assault / Collapse / Fall / Others	11	715.14 $\pm$ 394.83	-1.14	38	0.26
AVP/ Firearm / Edge weapon	29	927.48 $\pm$ 567.36			

Note: *p<0,05.

Discussion

Polytrauma represents a significant global public health concern, with notable economic, social, and political implications for both patients²² and society at large.⁹ A substantial body of compelling evidence supports the assertion that polytrauma patients are more effectively managed in tertiary-level care facilities.^{11,12} However, the absence of data on the financial implications of patient care may present a challenge to the financial accessibility of trauma care in a context where the country is in the initial stages of implementing UHC. The aim of this study was to address the existing data gaps. In light of the cross-sectional nature of the data, we restricted our analysis to the calculation of direct costs, integrating all elements of patient care.

The number of patients included in our analysis is relatively modest (n=40), as observed in the studies referenced in⁹ and.⁵ However, the number of cases continues to increase due to road accidents, as evidenced in the literature,^{22,23} which represents the primary cause of multiple trauma in our environment (65.00%).

The most prevalent vital distress in our setting was neurological, occurring in 60% of cases and representing the most frequent clinical feature. The mean total hospital stay was 27.8 $\pm$ 42.5 days, with the majority of patients (37.5%) requiring hospitalisation for a duration of 1–10 days. The mean duration of intensive care was 3.9 $\pm$ 3.2 days. The mean length of stay in the hospitalisation ward was 23.8 $\pm$ 41.8 days, with the majority of patients (57.5%) having been in the hospitalisation ward for a period of 1 to 10 days. Patients admitted to the intensive care unit are at elevated risk of infection, which can nearly triple the financial costs and extend the length of hospitalization.^{5,24}

The sociodemographic characteristics of the population under investigation were found to be similar to those observed in the evidence. The age range was 9 to 45 years, with the 19 to 28 age group being the most affected (40%), followed by the 29–38 and 39 to 45 age groups with 25% each. This finding is consistent with the results reported in epidemiological and economic studies^{21–23} which indicated that polytraumas predominantly affected the young and active population, with a male predominance (82.50%).

The mean direct cost in this setting was USD 608.77 $\pm$ 370.85, with a range of USD 139.78 USD to USD 1826.34. However, this does not accurately reflect the financial cost of managing multiple trauma incurred by patients in this province, as hospital care is relatively cheaper compared to some local hospitals.

Our findings were in close alignment with those reported in the existing literature,^{21–23} with the exception that in our study, the predominant mode of payment for these costs was direct (out-of-pocket), and the latter constituted a value exceeding 93.79 $\pm$ 57.13% GDP per capita (ranging from 21.54 to 281.36% GDP per capita). However, the consequences of this payment method expose patients and households to a dual risk of illness and financial difficulties.^{18,19,25} Furthermore, the provision of care is impeded by the dearth of pre-hospital medicine and the low socio-economic status of the populations at risk.¹⁴

It is imperative that the national health financing system is designed in such a way that it ensures that people have access to services when they need them, whilst also protecting households from financial catastrophe by reducing out-of-pocket payments.

The mean direct cost was found to be higher in instances where polytrauma patients were admitted to the intensive care unit and those who were hospitalised for a minimum of 43 days. These differences were found to be statistically significant at the 5% level of risk. Our findings align with those of,²⁶ who identified a correlation between the observed increase in costs and prolonged hospital stays. In contrast with the findings of,^{21–23} which indicated that costs were higher in patients with extremity injuries. Aunón Martín attributes this increase in expenditure to the surgical procedures associated with orthopaedic injuries.²⁷

Implications for Clinical Practice and Research

The clinical implications of this work are numerous, particularly in highlighting certain aspects that cause delays in treatment and have a direct impact on the vital prognosis of patients, while increasing the financial cost of their care. It is imperative to recognise that the management of a polytrauma patient commences at the scene of the trauma with the implementation of emergency procedures. These procedures must be meticulous and well-coordinated, encompassing the collection of data, the stabilisation of any emergency, and the expeditious transport of the patient to an appropriate facility for effective management. The efficacy of these procedures is contingent upon their swift execution, a factor that significantly impacts the patient's prognosis.²⁸ It is therefore recommended that teams of well-trained first-aiders and well-equipped ambulances be established in facilities where they are not currently present. This recommendation is based on the findings of a study conducted in a hospital where 55% of patients were brought by relatives in taxis or buses, 17% by motorbike, and untrained individuals used other means several hours after the trauma occurred. The timely management of polytrauma patients has been shown to reduce mortality, limit hospital stays and reduce the risk of post-trauma sequelae. Consequently, this approach contributes to a reduction in financial costs by decreasing the duration of hospitalisation.

The evaluation of lesions in patients with multiple injuries is typically conducted through clinical assessments. However, the incorporation of paraclinical examinations can significantly enhance the diagnostic accuracy and reliability of the assessment.^{29,30} It is recommended that hospitals treating polytrauma patients should be adequately equipped to carry out additional examinations (CT scan, X-ray, ultrasound, laboratory for emergency examinations and MRI if possible). The hospital where this research was conducted is found to be lacking in the requisite equipment, a situation which is identified as a significant contributing factor to delayed diagnoses and treatments. This is further compounded by the additional financial burdens incurred by patients and their families, as certain examinations must be conducted elsewhere and the costs of transporting the patient are incurred. It is noteworthy that these patients are frequently accompanied by family members or nursing staff, yet the financial burden falls upon the patient and their family.

It is imperative that hospitals incorporate severity scores for polytrauma patients, such as the ISS score,³¹ into their daily clinical practice when categorising patients. This helps to identify the most serious patients and to direct treatment accordingly, as well as standardising precise protocols so that staff do not have to improvise for each case.

It is recommended that researchers from a variety of backgrounds be encouraged to conduct more in-depth studies on the issue of polytrauma, with a particular focus on its financial aspects. These studies should be conducted not only during the acute phase of the condition, but also in the long-term follow-up of polytrauma patients, employing the microcosting approach.

Limits

The costs documented in this study are likely to be underestimated for two primary reasons. Firstly, Sendwe Hospital, although designated as a provincial referral hospital, does not accurately reflect the costs incurred by patients for the treatment of trauma patients in Haut Katanga province, let alone in the Democratic Republic of Congo as a whole. This is

due to the fact that hospital care is relatively cheaper in state health care facilities compared to some private hospitals in the same town.

The retrospective design of the study means that certain other costs are not taken into account, including the costs of transporting the patient and family members, special food, certain medical consumables related to dressings, injections, etc. Consequently, the costs reported may be underestimated. This is a limitation of the study.

Conclusion

The results of this study provide insight into the financial burden of polytrauma. The number of polytrauma patients during the study period is relatively small (40), yet their financial impact on households and polytrauma patients puts them at risk of catastrophic health expenditure. This may prove useful for the organisation of trauma care and also serve as a basis for further studies to evaluate the effectiveness of trauma interventions. It is possible to construct a national health financing system that protects households from financial catastrophe by reducing out-of-pocket payments. This can be achieved by taking into account the clinical characteristics of patients, including the severity of injuries and length of hospitalization. This approach ensures equity. It would be beneficial to extend economic studies to other polytrauma care health facilities.

Data Sharing Statement

The original contributions to this study are presented in the article, and the database supporting this manuscript is provided in Additional File 1 and is available from the publishers.

Disclosure

The authors report no conflicts of interest in this work.

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