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Cost Analysis of the Acute Spinal Cord Injury Ward and ICU Costs at a Tertiary Hospital in South Africa: What Is the Cost Per Patient Per Day?

Schalk Klopper*, Nicholas Kruger

Faculty of Medicine and Health Sciences, Department of Surgery, Division of Orthopaedics, University of Cape Town, Cape Town, South Africa.

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***Corresponding author:** Schalk Klopper, Faculty of Medicine and Health Sciences, Department of Surgery, Division of Orthopaedics, University of Cape Town, Cape Town, South Africa.

Abstract

Background: The cost of spinal cord injuries is a huge burden on the healthcare system. Costs vary from acute hospital admission to chronic rehabilitation and lifelong medical expenses. The true cost of a spinal cord injury admission to a spinal cord injury unit is not known. This study is the first of its kind to be conducted at Groote Schuur Hospital and there is limited published data on similar previous studies, especially in South Africa. The outcomes of this study can help to ensure the appropriate allocation of funding and distribution of resources in the healthcare system. The study aimed to obtain an overall figure of the cost per patient per day in the acute spinal cord injuries ward and its intensive care unit. **Objectives:** To determine the per patient per day cost of the wards. **Methodology:** Prospective audit of acute spinal cord injury unit ward and ICU costs at Groote Schuur Hospital over a 24-hour period. The audit included objective and calculated costs of services required to run the wards as well as consumables, investigations, and staffing. Accurate measures of obtaining and measuring these costs were performed and a per patient per day cost was calculated. **Results:** The study has shown that it will cost R4186.98 per patient per day in the acute spinal cord injuries ward and R28176.77 per patient per day in the acute spinal cord injuries intensive care unit. It is 6.73 times more costly to be a patient in the intensive care unit than it is to be in the ward. **Conclusion:** This study revealed and confirmed that it is cheaper for a patient to be admitted into the acute spinal cord injuries ward than into the acute spinal cord injuries intensive care unit over a 24-hour period. It shows that appropriate management of bed occupancy and down referral from ICU to general wards or from wards to step-down facilities will drastically reduce the cost of admission. This study aims to provide a foundation for future research on this topic.

Keywords

Spinal cord injury, intensive care, health economics, healthcare management

1. Introduction

Acute spinal cord injuries have proven to be a huge burden on the South African health care system. This study has been conducted to create a solid foundation on which future decision-making and research can be based. There

is currently a lack of literature regarding the running cost of wards in public hospitals in South Africa.

The total cost of a patient per day in the acute spinal cord injury ward and its equivalent intensive care unit (ICU) can be utilized to encourage the relevant administrative heads in government and management to refer patients, once stable, to more cost-effective rehabilitation centers. Moreover, this research can provide the current hospital staff with a greater awareness of the cost of resources, and thereby, encourage them to use resources appropriately to cut costs where necessary [1].

Limited research has been conducted on the running costs of hospital wards in South Africa, however, according to previous research conducted by Professor Ramjee et al, the average cost per admission at a public hospital in 2010 was R8777. This study highlighted the difference in admission costs of public hospitals compared with private hospitals and aimed to compare the cost of delivering services in the two sectors. The data used in this research was freely available data on public domains [2] with a limited database, but it does still provide a benchmark figure for costs.

Previous research conducted about spinal cord injuries and admission costs found the use of active pressure sore interventions in the acute spinal cord injuries ward reduced costs [1]. It was found that R738 239 was saved annually if certain preventative measures were taken to prevent pressure sores in the spinal cord injury ward [2]. In addition, the patient cost per day was R1250 in 2008 [2]. These findings were made available to the hospital finance department and used to plan budgets and allocate resources appropriately.

Subsequently, epidemiological studies have been conducted on spinal cord injuries in South Africa [3]. One such study surveyed the demographics and epidemiology of the patients admitted into the acute spinal cord injuries wards over one year and found that over 13 years an average of 185 patients were admitted yearly to the spinal cord injury unit at Groote Schuur Hospital in Cape Town. This paper highlights the large burden of spinal cord trauma that a tertiary hospital in South Africa has to service and emphasizes the importance of understanding the costs related to these admissions.

Evaluating the costs related to spinal cord injury care and ward expenses is invaluable [4, 5]. In a pressured healthcare system, efficient use of current available resources is of paramount importance. Without accurate data, managing these resources is challenging, and the correct allocation of state funding is not possible. This study has not been done yet in South Africa, and the results can be used as the basis for further research. A systematic review of 30 articles in the literature showed the acute cost of spinal cord injuries worldwide ranged from $290 to $612,590 [4]. The wide range and varying costs between developing and developed countries show us that actual costs vary greatly between different institutions and between developed and developing countries.

The purpose of this study is to get an overall figure representing how much it costs the hospital for a patient to be admitted into the ASCI ward or the ASCI ICU per day. This figure can be used to compare and assess cost efficiency in the government setting. The burden of spinal trauma is increasing and funding allocation to the various components of spinal care needs to be managed correctly. The costs associated with the acute care of SCI also emphasize the importance of spinal cord injury rehabilitation centers that manage patients further once over the acute phase of injury.

2. Methodology

Data was collected at Groote Schuur Hospital Acute Spinal Cord Injury unit in Cape Town South Africa. Costing categories and specific elements were identified based on professional opinions from doctors and nursing staff working in the unit. Data collection was performed over a 24-hour period in the ASCI ward and ASCI ICU. A total of 15 patients in the ward and 6 patients in the ICU were included.

Patient files including doctor, nursing, and allied professional notes and prescription charts were reviewed and audited. Information regarding admission dates and length of stay as well as daily investigations and interventions were recorded. Consumables used were documented and captured from patient files.

The electricity usage was measured using a flow meter which measured the electrical current in various electrical phases of each supply. A flow meter was attached to each electric board in each ward. The voltage and cost per kilowatt hour were obtained from the electrical engineering department. The voltage and current could then be used to determine the power that is used in each ward and subsequently the cost of the electricity could be calculated. The total electricity used in 24 hours could then be divided according to the number of beds in the wards to get a per patient per day cost.

The air conditioning cost was measured and calculated in a similar method to the electricity. The current of the air conditioner was measured using a flow meter that was connected to the electrical wiring powering the wards

from the inter-floor of the hospital. The voltage and cost per kilowatt hour were obtained from the hospital's electrical engineering department. The voltage and current were then used to calculate the power supplying the air conditioner and the cost of the power could then be calculated.

Water is used in each ward to wash the patients, to flush the toilet, and by staff to practice hand hygiene. The number of toilet flushes per 24 hours was measured, with the average toilet flush using 10 liters. The amount of water used to wash the patients was measured by the volume of water used per washing bucket at the specified filling level. This amount was then multiplied by the number of times the patients were washed per day

Oxygen was calculated by using the flow meters attached to the patients' beds. Only the patients in the ASCI ICU are on constant 100% oxygen. There are five patients a month in the ASCI ward on full oxygen. Afrox, who supplied the hospital with oxygen, provided the cost per kg for a tank of oxygen. From this, the cost per kilogram of oxygen was calculated.

Patient files and the digital laboratory system were used to obtain which laboratory tests had been conducted on the patients in the ward. We took into consideration that laboratory tests are taken on average twice a week per patient and additional tests were accounted for. The National Health Laboratory Service used by the hospital was able to provide the state prices for each laboratory test. This information was used to calculate the cost of laboratory tests.

Patients needing blood gas analysis were measured by reviewing folder numbers used on the blood gas machine and folder review. Blood gas analysis costs were provided by the manufacturer's representative technician.

Pressure matrasses are rented from an external company and pricing was provided. From this, the length of time the mattresses are used in the ward and the cost of the mattresses per month was calculated. The total cost of renting the mattresses per ward was then divided by the number of beds in the ward to get a per patient per day cost.

The pharmaceutical department at GSH has records by ward of the quantity and the type of medication that the wards order. The department was able to provide us with this information as well as the cost of each medication. From this, the total cost per month could be calculated into a per patient per day cost.

The financial department in charge of costing food made in the hospital kitchen provided the cost of the standard meals given to each patient in the ward on a daily basis. In addition, the acute spinal cord injuries dietician provided the cost of the additional supplemental feeds that each patient in the ASCI ward consumes on a daily basis. These values were then used to calculate the cost per patient in each ward.

Laundry expenses and costs were provided by the outsourced laundry company that is employed by the hospital. The laundry company used does not specifically charge items but rather charges per item washed to standardize costs. Laundry logbooks were used to calculate the cost of laundry per ward. This amount was further divided into a cost per patient per day.

Waste disposal was calculated per day and this figure was provided by the waste removal management department. However, waste disposal is not calculated for each individual ward. Infectious waste is collected separately from drug waste and is more costly to remove. The waste management supervisor used the total number of bags of waste collected from each ward to calculate how much infectious and normal waste is processed from each ward. This information was used by the waste disposal department to calculate the total costs of waste disposed and processed per ward per day.

The patient file numbers were entered into the PACS computer system. This system has a record of all imaging including x-rays and scans that each patient had and a sample for one month was taken. The cost of the radiological procedures was provided by the financial administration department.

Telephone records from each ward were obtained and costs were calculated per call based on standard tariffs. Many interhospital calls were made and not charged, all other calls were accounted for.

The consumables ordered every two weeks were counted and costs were acquired from the supply chain management. The records and receipts of the orders are kept in the ward too. The receipts for the month were recorded and used to calculate a daily cost. The price of splinting materials was gathered from the Occupational Therapist Department in GSH.

The human resources department at GSH provided all staff in the hospital. The number of hours each worker spent in the two wards per day was calculated by reviewing work schedules and rosters. The porters and cleaners in the hospital are centralized, therefore, the total average notch salary was divided by the number of beds in the hospital to get the cost per patient and further divided by 365 to get the daily cost per patient. The nursing staff work a standard amount of hours per month and hours are recorded daily. This was used to calculate nursing costs, taking income and salary levels into account for different levels of nursing staff. The allied health professionals work in many wards. Therefore, their total salary was broken down into per-day and per-patient costs and correlated with

time spent in the respective wards to estimate the closest possible cost. The medical doctors' salaries were broken down into cost per day.

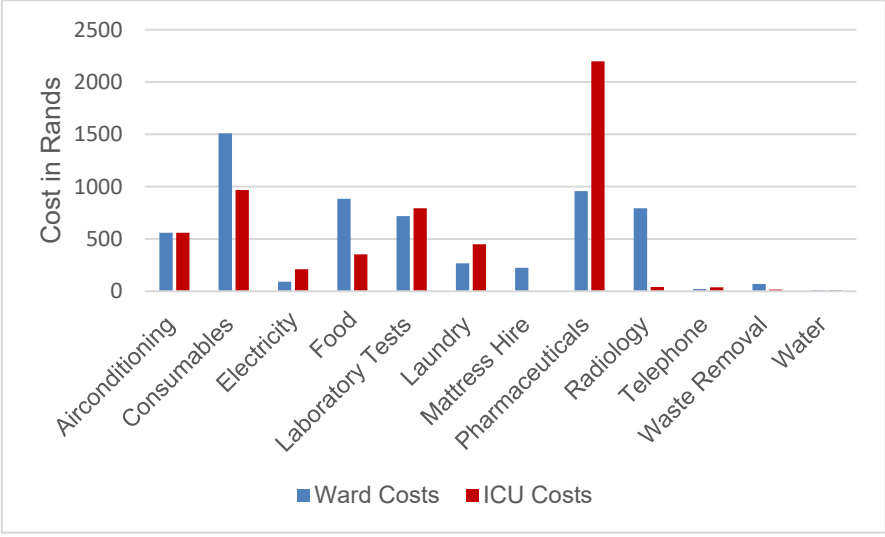
3. Results

The costs attributing to the summative costs per patient per day are summarized in Table 1 and are represented graphically in Figure 1.

The total cost of admission to the ASCI ward was calculated to be R 4193.03 per patient per day, while admission to the ICU costs R 28 176.75 per patient per day.

Table 1. A table showing itemized costing for the ASCI ward and ICU

	WARD	ICU
	Cost in Rands	**Cost in Rands**
Air-conditioning	558.91	558.91
Consumables	1509.77	967.43
Electricity	90.52	210.09
Food	883.69	353
Laboratory Tests	718	793.71
Laundry	266.75	448.25
Mattress Hire	224.78	0
Oxygen	13248	119232
Pharmaceuticals	956.43	2198.29
Radiology	792.54	40.84
Staff	43546.66	44194.86
Telephone	20.06	37.53
Waste Removal	69	16.69
Water	10.28	8.91
TOTAL COST PER DAY	**62895.39**	**169060.51**
Number of Patients	n = 15	n = 6
TOTAL COST PER PATIENT PER DAY	**4193.03**	**28176.75**



Figrue 1. A graphical representation showing the comparison of itemized costs for the ASCI ward and ICU respectively.
(Note: Costs of oxygen and staff have been omitted)

Table 2. Human resources cost per day

Job Title	WARD Cost (Rands)	ICU Cost (Rands)
Cleaners	1 020,12	408,05
Dietitians	196,50	78,60
Medical doctors	33 542,71	33 542,71
Nurses	8 051,46	9 947,90
Occupational therapists	255,72	102,29
Physiotherapists	101,87	0
Porters	288,28	115,31
Total	**R43 456,66**	**R44 194,86**

4. Discussion

The results above indicate that it will cost R4186.98 per patient per day in the ASCI ward and R28 176 per patient per day in the ASCI ICU ward. The equivalent dollar values are 249,09 USD for daily ward costs and 1 676,25 USD for daily ICU costs.

Admission into the ASCI ICU ward is 6.73 times more expensive than being admitted into the ASCI ward, so the earlier a patient can transferred from the ICU to the normal ward, the greater the cost savings.

The greatest cost by far, in both wards, is the cost of staffing, which is similar in the ASCI ward and ICU. Therefore, the earlier patients are referred to facilities with fewer specialized staff members, the greater the cost savings. This highlights the importance of rapid and efficient referral pathways to rehabilitation and care centers, with minimal administrative lag, where the daily costs of care are substantially less than in the acute wards.

When the daily costs of the ASCI ward are directly compared to the ASCI ICU ward, the ward appears to be more expensive, but in terms of per-patient costs, the ICU per-patient cost is substantially more than the ASCI ward.

In the study conducted by Ramjee et al. [1], it was found that the average cost per admission at a public hospital in 2010 was R8777, which is not comparable to our per patient per day cost since it measured overall admission costs. This demonstrates the need to have comparable studies since SCI patients have substantially longer admission times than the average hospital in-patient (the ASCI Unit average admission time was 46.8 days/patient 2016-2020). Our average cost per admission in the spinal unit would thus be R196 000 per patient.

In the study conducted on the pressure sores intervention in the ASCI ward at Groote Schuur [2], it was found the cost of admission per patient was R1250 per day. This amount is less than half the current calculated cost per patient per day of R4186.98 in this study. This is likely due to the fact that the authors used a global average admission cost over the whole hospital (less accurate as ASCI length of stays is substantially longer than the average) coupled with inflation-related price increases over the years. In this study, costing was more accurate as it was a dedicated audit of the spinal cord injury unit.

The information gained in this study on the cost of admission to the ASCI ward and ICU can be used to support and guide further studies on the impact of cost in healthcare systems. It highlights the necessity for a healthcare system that depends on dedicated rehabilitation and step-down facilities to accept patients seamlessly and save on unnecessary hospital costs. It also highlights the need for appropriate admission protocols into ICU facilities and avoidance of unnecessary critical care in patients with hopeless prognoses.

This study is a first of its kind in South Africa and it is not without limitations, mainly the small sample size in determining costs. Increasing the time frame over a 3- or 6-month period would increase the accuracy of the study and also include more patients for data analysis. Other hidden costs such as maintenance costs and purchase of ward fixtures and equipment were also not accounted for in this study.

5. Conclusion

The study aimed to obtain an accurate figure representing the total cost of a spinal cord-injured patient being admitted into both the ASCI ward and ICU for a 24-hour period. This figure was calculated by auditing the individual costs comprising the total running expenses of these wards over 24 hours. Even with the limitations of the short time period and small patient cohort, this data is the most accurate costing analysis to date and the first one to

directly measure the costs of acute spinal cord injury care in South Africa.

Without insight into healthcare cost and efficiency in our healthcare systems, appropriate distribution of funds will only be an estimate, and imbalances in healthcare expenditure will result.

The outcome of this study can be used as a foundation on which further research can be performed in hospital economics, and cost savings and provide appropriate motivational evidence for health care budgeting in both the state and private setting or even the proposed national health care system.

Ethics statement

The authors declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, in 2010.

Ethical approval number HREC 667/2021. For this retrospective study, formal consent was not required.

Declaration

The authors declare authorship of this article and that they have followed sound scientific research practice. This research is original and does not transgress plagiarism policies.

Authors' contributions

Nicholas Kruger: study conceptualization, study design.

Schalk Klopper: data analysis, first draft preparation, manuscript preparation.

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