

Unit Costs and Its Drivers for Hypertension Treatment in Emergency Department of Muhimbili National Referral Hospital in Dar Es Salaam, Tanzania

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Abstract: Importance of economic evaluations in public sectors cannot be over emphasized as now when funding is scarce especially the health sector which is regarded as a consumer. Objective was to evaluate the unit costs of Hypertension and treatment and their drivers in Muhimbili National Hospital (MNH), Tanzania A cross-sectional descriptive hospital-based (direct cost-provider perspective) study was carried out from July to Sept 2020 in Emergency Department of MNH. The study horizon and analytical horizon were both one year (January to December 2019). Costing of materials, diagnosis and invested time were estimated from patient's electronic files. Treatment information and analysis were done using Microsoft excel for quantitative data. Bottom up approach was used to arrive at the total and unit cost of the health conditions. Estimated unit cost for treating hypertension was TZS 165,465 where main cost driver was length of stay, which drove the providers cost. Sensitivity analysis showed that, cost of health personnels is the driver of unit cost for hypertension treatment. Furthermore the high cost was due to higher waiting times patients spend while seeking treatment and that reduction of the average length of stay by 50% resulted in 50% reduction in the unit cost of treating hypertension. Unit cost for providing treatment to hypertensive patients is high. Annual unit cost studies should precede budgeting and pricing for services offered by the department so as to optimize cost of providing services. Prioritizing preventive services especially annual health checks could lower curative services costs

Keywords: Unit Cost, Hypertension, Health Care Providers

1. Introduction

Lack of economic evaluation of unit cost in delivery of hospital services in developing countries public hospitals has led to poor resource allocation (budgeting and pricing). [1] This is mainly caused by unawareness of importance of unit costs, and lack of costing experts, lack of expertise in the use of information related to economic evaluation in operating public hospitals [2] Hypertension is a major health problem throughout the world because of its high prevalence and its association with increased risk of cardiovascular disease. [3] The disease is characterized by blood pressure greater or equal to 160/95 mmHg (from an average of two measurements), or the use of antihypertensive drugs [4]

Antihypertensive drugs are generally categorized into three groups: Diuretics, Adrenergic inhibitors that act centrally, peripherally or as receptor blockers and Vasodilators that act directly via calcium channel blockade, ACE inhibition or angiotensin receptor blockade. [5] Diagnosis related costs analyses are the subject of science and research and are of great relevance and importance for decision makers in the hospital and for funding bodies, but also for international health policy

In the year 2000, over 900 million people were hypertensive of whom about 60% were from developing countries, the number is predicted to increase to a total of 1.56 billion people by 2025. [6] The strategic action plan for prevention and control of non-communicable diseases in

Tanzania 2016 – 2020 reports that in Tanzania, the prevalence of hypertension is estimated to be around 26% [6].

Unit cost analysis is one of the most useful yet underused tool because it takes into account most of the resources associated with providing a particular service and calculates how much it costs to provide that service. [7] Standardized costs analyses with valid costs data are rarely available in developing countries for emergency patient care of patients with non-communicable diseases such as hypertension. [8]

This study sought to determine the unit cost of treating and the cost drivers for providing the treatment to hypertensive patients at the Emergency Department in Muhimbili National Hospital. An activity based micro-costing approach was used to estimate the total costs of attending to a hypertensive patient and average length of stay at the unit seem to be driving the unit costs.

2. Methods

2.1. Study Site

This study was conducted in the Emergency Department of Muhimbili National Hospital (MNH) in Dar Es Salaam Tanzania. This is a public referral hospital with 1500 beds and attending around 1000 to 1200 out patients per week. Average of 100 to 120 patients are attended per day in the emergency department of which 60% are admitted. Hypertensive patients are among the top three diagnoses that are treated at the department. Apart from providing health care services to patients from all parts of Tanzania, the department conducts teaching to students from medical colleges in the country and abroad.

The department collaborates with different teaching institutions including Muhimbili University of Health and Allied Sciences (MUHAS). The site was selected because there is only one national referral hospital with state of art emergency department that has been running for ten years now. The existence of and experience of personnel's working in the department makes it the best available option for the study. Clients at the department pay for the services by different methods. These methods includes health insurance and out of pocket (user fees).

2.2. Study Design

A cross-sectional descriptive hospital-based (direct cost-provider perspective) study that was carried out from July to Sept 2020. It is a cross-sectional because we dealt with prevalent cases and wanted to get the snapshot of the 2019 attendance/visits for the studied diseases.

The study horizon was one year and analytical horizon was also one year (from January to December 2019). A phenomenology study because cost is a phenomena

2.3. Data Collection Method

This is a study that employed a bottom up prevalence approach collecting both qualitative and quantitative information from patient's electronic files and health workers.

Patients files were used to provide quantitative information and Key Informants were selected from health workers in the department to provide the qualitative information. Medical stores department catalogue was used to provide the prices for different medicines, medical and surgical supplies used in the treatment of hypertension. Information was extracted from patients' files including diagnosis, medicines prescribed, medical and surgical supplies used by each selected patient. Providers (prescribers, nurses) involved in the provision of services to patients as well as the duration of treatment spent during attending to a patient were extracted from the electronic files. A bottom-up approach was employed to extract cost information that were incurred in providing care to patients; the input cost varied for the cases that were examined. The human resource costs and overheads were responsible for the large portion of the total costs' [7]

The total costs included all imputes that were ordered by prescribers and appeared in the orders column of patients' chart. Medications prescribed to all 150 diabetic patients as presented in the 'orders' and 'prescription summaries' columns of Wellsoft software. A count of doses prescribed were identified then total doses for each medication made. Cost of each drug was identified then multiplied by total doses to get total cost for all drugs prescribed. Formula used was $Q \times P = TC$ where Q is Quantities; P is Price and TC is Total Cost. All costs are expressed in TZS where the exchange rate is 1\$= TZS 2,289 Unit costs were calculated by dividing the total by the number of patients studied i.e. 155 hypertension clients.

2.4. Study Population

The study involved patients who visited the Emergency Department from January 1st to December 31st 2019 presenting with hypertension where patients electronic files, which were in the Wellsoft system were used to provide study data of selected patients.

2.5. Sample Size Determination

Table 1 shows the total number of patients seen in 2019 as 70,743 of which 1,582 were hypertensive. A samples of 155 hypertensive patient was randomly selected using the inclusion criterion that were used as a basis of selection

Table 1. Sample Size Determination.

| Total | Selected | |
|--------|----------|------------|
| | Number | Percentage |
| 70,743 | 1,582 | 2.20% |
| 1,582 | 155 | 9.80% |
| 70,743 | 155 | 0.20% |

Electronic filing system was accessed after obtaining permission from system administrator and the patients' files were downloaded from the system for the year 2019 for all patients diagnosed of hypertension. Lists of all files in the year 2019 were developed as the sampling frame. These strictly included only all files that had complete records. The files were randomly selected. About thirty patients' files that met inclusion criterion in each quarter of the year was be

randomly selected for each diagnosis. This was done to take care of seasonality during the year.

2.5.1. Inclusion Criteria

All files of adult (above 18 years of age) patients recorded with hypertension that were attended at the Emergency Department in the year 2019 (January to December) whose medical records were complete (with all records of a particular visit including time of arrival, all personnel names and credentials, time of departure, procedures done, medications issued, prescribed laboratory investigations results) recorded in the Wellsoft medical record system.

2.5.2. Exclusion Criteria

- a) Adult patients' files with incomplete information in the electronic files.
- b) Patients with co-morbidities

2.6. Data Collection Procedure

Quantitative data were collected from the emergency department annual reports generated from Wellsoft system made available as excel spreadsheets.

2.7. Costing Procedure

Costs were evaluated from provider perspective using micro-costing approach, first assessing the average cost of services consumed per individual patient then assessing the average time spent per individual patient by using data obtained from Wellsoft system. Health providers (Medical Specialist, Registrar/Residents and Nurses) costs were for each patient were estimated from their monthly salaries divided by salary per minute then multiplied by time spent for each patient in minutes.

Wellsoft generated reports for the three diagnosed health problems and transferred to excel format for quantitative analysis.

The following costing principles were abided by:

1. The study was based on provider information, hence provider costs were extracted. These were data on that which were incurred treating hypertension patients.
2. The unit of analysis is the health facility in this case Muhimbili National Hospital
3. The identified cost items involved included pharmaceuticals, diagnostic and procedures.
4. We measured cost items in its units (time-hours, personnel's wages, pharmaceutical quantities and diagnostics numbers)
5. We valued cost items in Tanzanian monetary value shillings as medium of exchange which could be converted into USD using the 2019.
6. Uncertainty (sensitivity) analyses were done for each disease to determine some of the drivers of the unit cost
7. Once cost centres were defined and their output determined, the input used to produce the output were defined, measured and valued. All input and their respective cost at a support centre was determined, and thereafter the annual cost of each type of input was

calculated by multiplying the unit price by the number of inputs consumed in 2019. Finally, all calculated costs of input was summed to obtain the total cost of the input of the cost centres for 2019.

8. After cost of inputs for the year 2019 were estimated, they were divided by the number of output units provided by the cost centre to generate the cost per output unit cost for each cost centre.
9. We calculated the total cost for each direct care centre which included adding the total cost of the direct care centres with the relevant support centres and the relevant costs of the indirect care centres and the costs of their respective support services.
10. We calculated the unit costs for each care centre once the total cost of input during a given time period has been estimated, it was divided by the number of output units provided by the care centre to generate the cost per unit of output.
11. We calculated the total cost of providing services at a service site after the unit costs and overall costs have been calculated for each relevant care centre, these were added together to produce the total cost of providing the services at the relevant service site. [8]
12. We identified the cost drivers and conducted sensitivity analysis for each disease.

An excel sheet for data used for recording information extracted from patients electronic files. The columns constituted subtitles such as medications, laboratory investigations, and duration of treatment, personnel, total costs and unit costs. Rows were constituted diseases under study, hypertension. Raw data tally sheets were used to count medications, lab investigations, time used by different cadres in the treatment provision, medical and surgical supplies used during patients treatment. Some of data sheets to be used for analysis of data collected includes individual diseases data sheets as elaborated below where the inserted tables' shows spaces for five patients but the tools are well elaborated in the appendix where space for patients is shown in the data sheets

The buying prices of pharmaceuticals and supplies were adopted from Medical Stores Department (MSD) price list [9] while personnel's salaries were extracted from Muhimbili national hospital salary scheme of service document. Personnel costs were calculated by determining the annual salary for each position for doctors, nurses, lab technicians and pharmacists. Thereafter the salaries portion were multiplied by the percentage of time dedicated to patients' treatment as determined by duration spent with the patient in the Wellsoft system.

2.8. Data Analysis

Microsoft excel software was used for the quantitative data. Summaries of cost Items were done using an excel sheets consisting of columns with sub-titles including diseases, total costs, total quantities, total costs divide by total quantities and unit cost. Rows were of a list of the diseases under study and beneath each disease specific costs items was be

listed such as unit cost lab, unit cost pharmacy, unit cost consultation and unit cost medical supplies.

The direct and indirect costs of each diagnosis was then added to get the full cost. To calculate the unit cost the average cost method was be used. For example, to find the unit cost per visit, the full cost of the emergency department was be divided by the total number of each disease patient visits at the department during the whole year. Salary scale reference sheet from public servants scheme of service was be used to guide salaries of different health personnel working in the department [12].

2.9. Ethical Issues

University research protocol was be adhered to as advised including seeking ethical clearance from research governing boards in University and Muhimbili Hospital. Written permission for data collection was be sought from hospital administration, specifically from directorate of research and publication as per stated procedures and shared with Emergency department head of department prior accessing the Wellsoft system for data retrieval. Confidentiality of patients' information was be ensured at all time by adhering to department procedures for accessing the Wellsoft system which includes using assigned password to enter the system and not sharing the raw information to third party. The rest of the data was stored in a folder in a computer, which was by a password. Individual files used in the study were assigned a number that was different from the medical records number. The medical record number was only known to Principal Investigator. The patients' files contained all retrospective data needed in this study

3. Results

The department attended 70,743 patients in 2019 calendar year, hypertensive of which 506 are included in this study. Study participants includes 10% of 1,582 hypertensive patients' files were studied. 80% of hypertensive patients were 46 years and above; Participation of Females was 53%, 49% and male 47%, 51% patients in hypertension respectively.

Patients' destination after treatment was used as criteria for categorizing severity of illness status in that; those transferred to Intensive care unit (ICU) were categorized as severely sick, those admitted to general wards as moderately

sick while those discharged to home as mildly sick. Results shows that; majority of patients with hypertension (61%) were categorized as having mild illness as described in table 3. Severely sick patients are more likely to spend more time in the emergency department than the mildly sick

Table 2. Patients Demographic Characteristics.

| AGE GROUPS | HYPERTENSION (N=155) | |
|------------|----------------------|-----|
| | NUMBER | % |
| 18-25 | 4 | 3 |
| 26-35 | 11 | 7 |
| 36-45 | 16 | 10 |
| 46-55 | 35 | 23 |
| 56-65 | 50 | 32 |
| 66+ | 39 | 25 |
| TOTAL | 155 | 100 |
| SEX MALES | 76 | 49 |
| FEMALES | 79 | 51 |
| TOTAL | 155 | 100 |

Table 3. Patients Illness Status.

| PATIENTS ILLNESS STATUS | | | | | | |
|-------------------------|----|----------|----|------|----|-------|
| SEVERE | % | MODERATE | % | MILD | % | TOTAL |
| 16 | 10 | 45 | 29 | 94 | 61 | 155 |

Hypertensive patients spent time seeking treatment for up to twenty two hours seeking treatment.

Table 4. Average Length of Stay (ALoS) In Department Seeking Treatment (Duration).

| ALoS | Hours | Minutes |
|---------|-------|---------|
| Maximum | 22 | 26 |
| Minimum | 0 | 11 |
| Mean | 8 | 46 |

3.1. Total Cost of Treating Hypertension

Itemization of each cost component to include medical personnel, medications, procedures conducted and supplies used, a total of TZS 42,288,797 emerged as the total cost of treating 155 hypertensive patients where health personnel were the highest cost while supplies was the list cost. Personnel constitutes the highest cost amounting to TZS 13,125,552 which is due to the long stays patients spend in the department. The disease has the most patients spending highest average length of stay of up to more than twenty two hours in the department hence resulting in more man hours of providing care

Table 5. Total Cost of treating Hypertension.

| SN | DESCRIPTION | NUMBER | UNIT COST | COST |
|----|-----------------------|--------|-----------|------------|
| 1 | PERSONNELS | 617 | 21,273 | 13,125,552 |
| | Medical Specialists | 152 | 37,893 | 5,759,688 |
| | Residents/registrar's | 157 | 19,934 | 3,129,712 |
| | Nurses | 308 | 13,754 | 4,236,151 |
| 2 | MEDICATIONS | 162 | 8,094 | 1,311,193 |
| 3 | INVESTIGATIONS | 550 | 14,018 | 7,710,100 |
| 4 | PROCEDURES | 115 | 60,908 | 7,004,400 |
| 5 | SUPPLIES | 10 | 1,200 | 12,000 |
| | TOTAL COST | | | 42,288,797 |

3.2. Unit Cost for Hypertension

The cost of treating one hypertensive patient per year at the department is estimated at TZS 272,831 per patient in one year

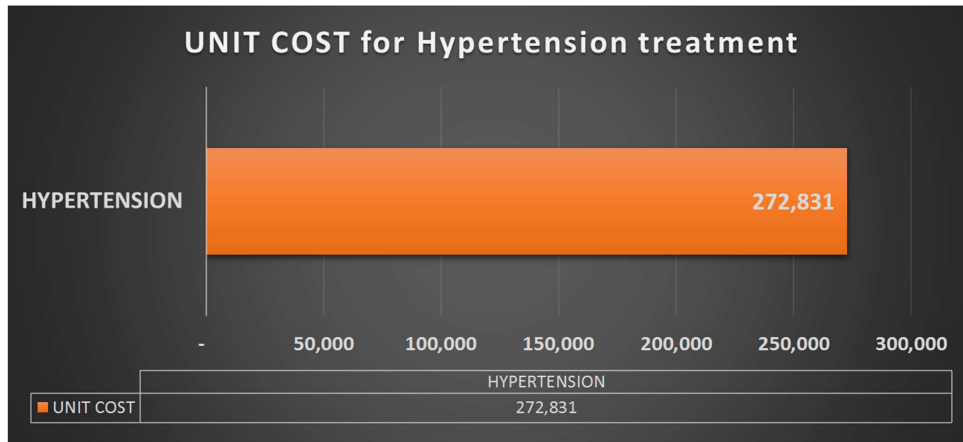


Figure 1. Unit Cost of Treating Hypertension.

3.3. Cost Drivers for Hypertension Treatment

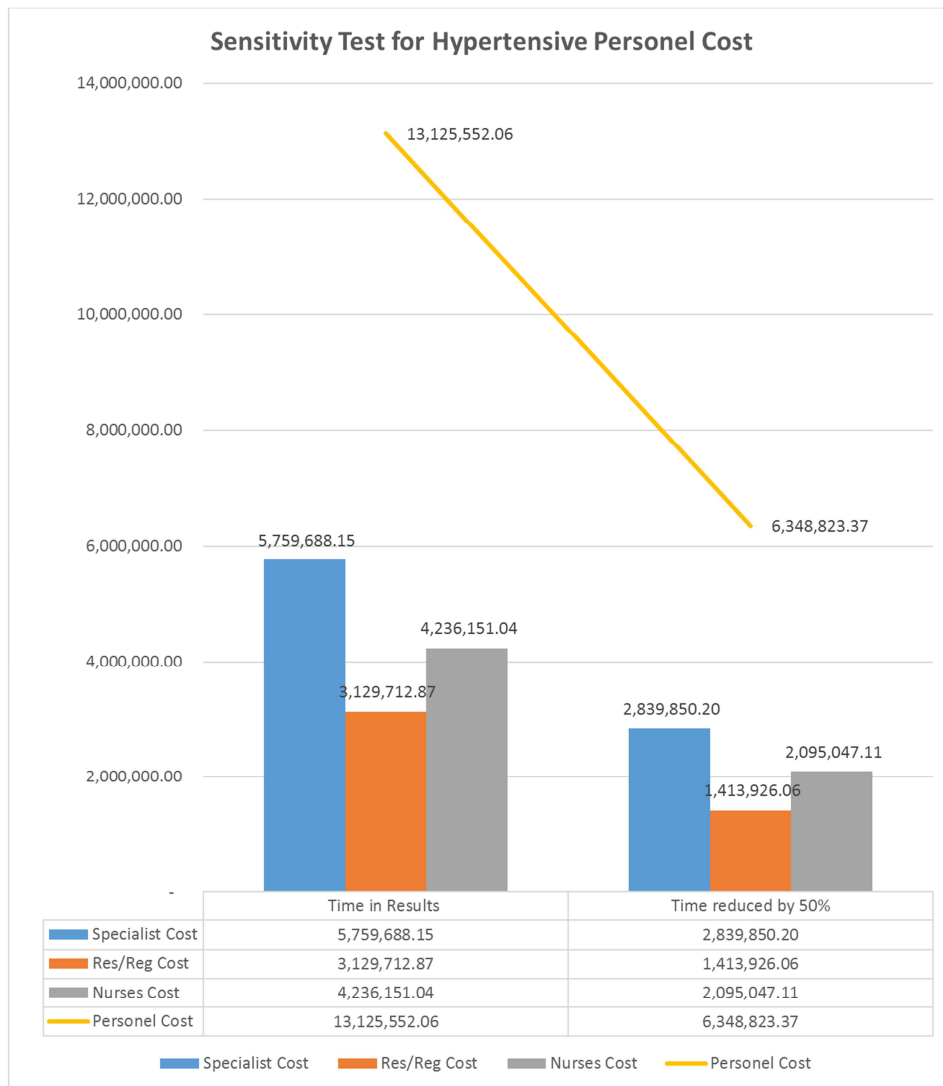


Figure 2. Sensitivity Analysis for Hypertensive Personnel Cost.

The highest cost in the treatment of hypertension is the personnel's cost. Personnel's cost is due to high average length of stay. Should the average length of stay be reduced to half the time, the result is reduction in cost by 50%

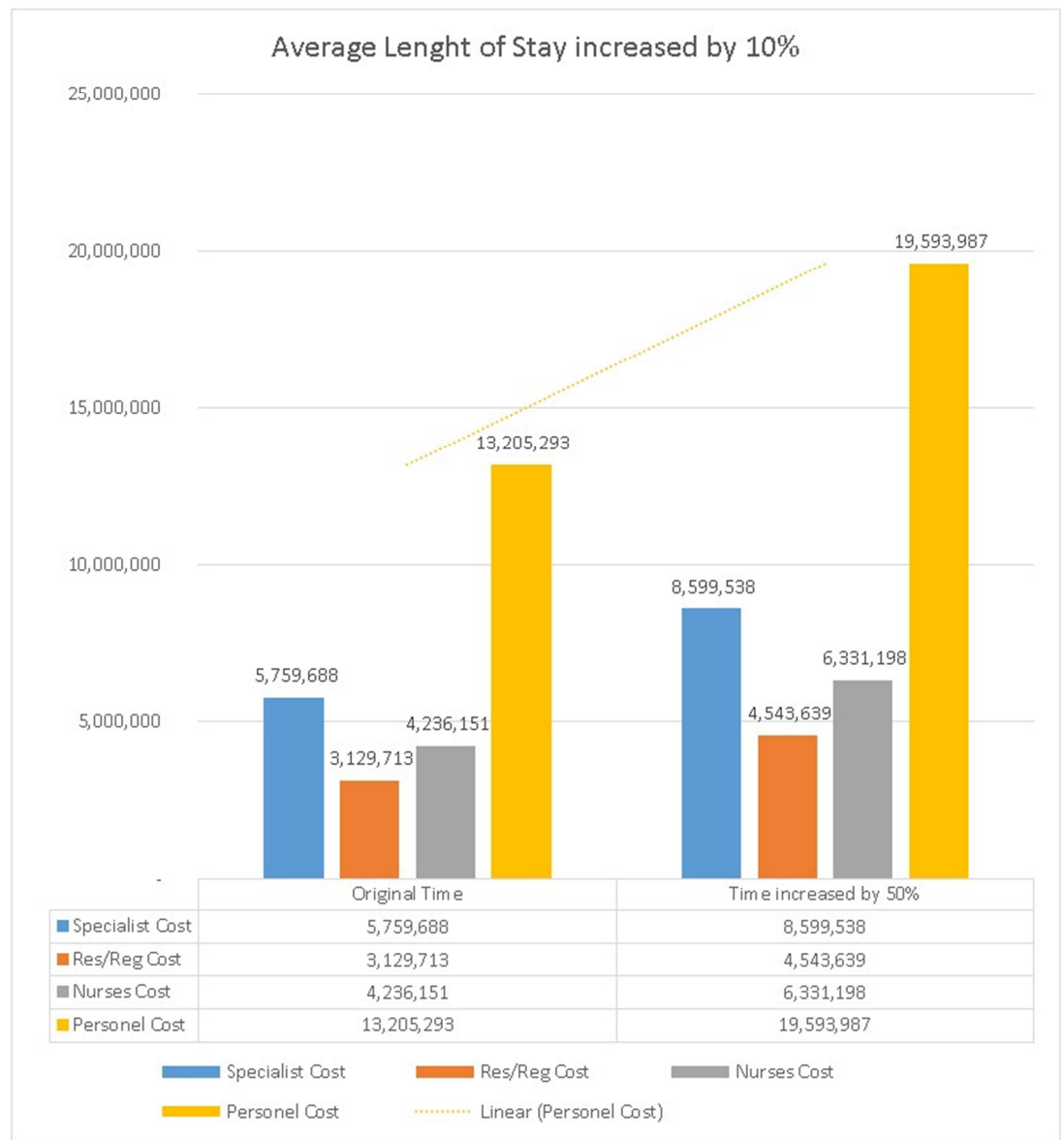


Figure 3. Length of stay for Hypertension patients increased by 50%.

All costs increased by 50% when length of stay for hypertensive patients was increased by 50%. In ideal situations, patients may spend more than average time in the department seeking treatment due to various reasons such as system down time and long queues at payment outlets. This study demonstrates that with increased stay result is increased personnels cost of treatment bon by department.

4. Discussion

The public health implication of the study is to provide unit cost information for identifying areas for future intervention by policymakers using the unit cost approach during budgeting and resources allocation. Efforts were made in this study to include the relevant cost components related

to managing Hypertension which included medications, health personnel, investigations and procedures done to patients with hypertension. The study also assessed cost drivers for, hypertension.

This study found the unit cost for Hypertension treatment to be high. Per patient per year cost of treating hypertension was more than two hundred and fifty Tanzanian shillings. Findings echo results by Teryl K Nuckols, who found that the cost to be U.S. \$170 per hypertensive person annually (2009 dollars). [11] Other studies on unit cost per patient found the cost to be US\$65 In a study in Vietnam by Thi-Phuong-Lan Nguyen in 2014 [12] and 803.45\$ on a study titled The cost of treating high blood pressure in general practice in France by Yael Tibi-Levy and Jeremy Westerloppe in 2008 [8]. In a study to find outcomes and costs of implementing a community-based

intervention for hypertension in an urban slum in Kenya, it was found that the awareness and screening component of the intervention accounted for 38% (US\$ 70 071) [13].

Furthermore, it was shown that high cost were due to personnel costs, medication and procedures done to patients. This is due to time spent providing care to hypertensive patients being higher than other diagnoses in this study. This can be attributed to type of patients received being in acute state that needs more interventions including waiting times for consultant cardiologist from a cardiac institute in the same national hospital. The high cost could also be attributed to the patient flow pattern at the department that could include some waste. In the study, the least cost were supplies and medications.

5. Conclusion

Unit cost for providing treatment to hypertensive patients at emergency department at Muhimbili national referral hospital is high. Annual unit cost studies should precede budgeting and pricing for services offered by the department so as to optimize cost of providing services and also improve strategic decision-making process including effective financial management, health care service planning and human resources management.

6. Recommendations

Future follow up of this work should be made so as to compare findings and understand the level of implementation of use of unit cost studies prior budgeting and resources allocation. Review of patient flow to identify wastes should be performed the soonest. [14] Following up strict implementation of standard operating procedures with the cardiac unit could help elimination of cardiologist review wait times. At national level, prioritizing preventive services especially annual health checks could lower curative services costs [15]. Finally, conducting patient perspective research would shade light on the patients' financial experiences with regarding to treatment costs incurred while attending to the emergency department. Benefits of including Patient and Public Involvement and Engagement in research can include identifying the important research questions, ensuring participant burden is minimized, supporting analysis and providing advice on dissemination, particularly to lay audiences [16].

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