

**ANALYSIS OF MEDICINES EXPENDITURES AND  
PHARMACEUTICAL INVENTORY CONTROL MANAGEMENT  
AT MUHIMBILI NATIONAL HOSPITAL**

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**MSc (Pharmaceutical Management) Dissertation  
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PHARMACEUTICAL INVENTORY CONTROL MANAGEMENT  
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**By**

**Tumaini Harrison Lyombe**

**A dissertation submitted in partial fulfilment of the Requirements for the Degree  
of Master of Science in Pharmaceutical Management of  
Muhimbili University of Health and Allied Sciences.**

**Muhimbili University of Health and Allied Sciences  
November 2013**

**CERTIFICATION**

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled “**Analysis of medicines expenditures and pharmaceutical inventory control management at Muhimbili National Hospital**” in (partial) fulfilment of the requirements for the degree of Master of Science in Pharmaceutical Management of Muhimbili University of Health and Allied Sciences.

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## DECLARATION AND COPYRIGHT

I, **Tumaini Harrison Lyombe**, hereby solemnly declare that this dissertation is my original work and it has not been presented nor will it be presented to any other University for similar or any other degree award.

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

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## **DEDICATION**

This work is dedicated to my husband Marco, my daughter Millen and my two sons Brian and Trevin.

To my parents too, Mr. and Mrs. Harrison Lyombe

I love u all very much.

## ABSTRACT

**Background:** Good pharmaceutical management is an important approach to contain the increasing expenditures on medicines in developing countries. ABC and VEN analyses classify items according to their budgetary consumption and importance, respectively. When the two are combined together they increase efficiency in medicines supply chain systems and also diminish costs associated with overheads, wastages and inefficiencies. This study uses ABC and VEN approaches to analyse medicine expenditures and further explores inventory control methods employed and the associated challenges at Muhimbili National Hospital-Tanzania

**Methods:** This was a descriptive hospital based cross-sectional study which was conducted at Muhimbili National Hospital. Data were collected using pre-tested questionnaires and through document reviews. Analysis was performed by using Excel spreadsheet (Microsoft Excel®, Microsoft Corporation) and SPSS version 20 computer software.

**Results:** The annual medicines expenditures was 1.2 billion Tanzanian Shillings (approx 750,000 US \$) which is equivalent to 1.3% of the total annual hospital expenditures. About 394 medicines were procured during the financial year, 143 from MSD and 251 from other suppliers. Overall, 46 (12 %) medicine belong to class A and 67 (17 %) to the vital category, based on ABC and VEN classifications. About 270 (approx 70%) medicines were essential and consumed 70% of the budget. Of the 143 medicines procured from the MSD, 8 consumed 50% of the budget; ceftriaxone injection (1 gram) alone contributing 15 % and only 4 of the class A items were Vital. Of the 251 medicines procured from other suppliers; 14 consumed 50% of the budget, and meloxicam and augmentin tablets together contributed 16 %. Only 6 of the class A items could be classified as Vital.

There was no special inventory control methods for class A items which are main drivers of medicine expenditures. Even though shortage of human resource is a major challenge **for the**

pharmacy department, majority of the existing pharmaceutical personnel do not have sufficient expertise in inventory management.

**Conclusion:** Based on the ABC and VEN analyses, there is inefficiency in allocating the scarce financial resources to medicines at Muhimbili National Hospital. Even for the few class A medicines which consumes nearly three-quarter of the budget, there is no special monitoring mechanisms to ensure rational prescribing and inventory management. In order to allocate scarce resources efficiently and to manage pharmaceutical inventories effectively, priority-setting decisions must employ ABC and VEN classifications.

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**LIST OF ABBREVIATIONS**

ABC	ABC Classification on basis of consumption value of item
ADE	Annual Drug Expenditure
AHE	Annual Hospital Expenditure
CAG	Controller and Auditor General
CII	Cost Inflation Index
EDRS	Electronic Drug Record System
EML	Essential Medicines List
EOQ	Economic Order Quantity
FEFO	First Expire – First Out
FSN	Fast Slow Normal
GDP	Gross Domestic Product
GoT	Government of Tanzania
GRN	Goods Receiving Note
HTC	Hospital Therapeutic Committee
LPO	Local Purchase Order
MNH	Muhimbili National Hospital
MoHSW	Ministry of Health and Social Welfare
MSD	Medical Stores Department
NEMLIT	National Essential Medicines List of Tanzania
NSAID	Non-Steroidal Anti-Inflammatory Drugs
PVMS	Priced Vocabularies of Medical Stores
ROP	Reorder Point
TPE	Total Pharmaceutical Expenditures
TZS	Tanzanian Shillings
VEN	Vital, Essential, Nonessential
VED	Vital, Essential, Desirable
WHO	World Health Organization

## CHAPTER ONE

### 1. INTRODUCTION

#### 1.1 BACKGROUND

One of the targets of Millennium Development Goal 8 (MDG) as per medicine perspective is to increase access to essential medicines in developing countries (WHO, 2007). One of the proposed means to achieve this goal is by increasing medicines budgets. However, developing countries particularly the sub-Saharan African countries including Tanzania are in critical shortage of financial resources for healthcare. Therefore health institutions especially hospitals at all levels have to make sure that the existing limited healthcare resources are used efficiently prior to budget increase.

##### **1.1.1 Pharmaceutical expenditures and control:**

Total pharmaceutical expenditures largely depends on two factors which are price and quantity of medicines purchased. According to the 2004 World Medicines Situation report, it is shown that the rate of change in Total Pharmaceutical Expenditures (TPE) has been greater than the rate of change in Total Health Expenditures (THE) and Gross Domestic Product (GDP) in a number of different countries worldwide (WHO,2004). In 2005/2006 per capita pharmaceutical expenditures ranged from US\$ 7.61 for low-income countries to US\$ 431.6 for high-income countries (WHO, 2007). There is a need for low-income countries to have cost containment strategies so that the pharmaceutical expenditures are kept at a realistic height.

The major goal of any hospital pharmaceutical supply system is to ensure that sufficient stock of necessary items is available and there is continuous supply all the time. Hospitals should be equipped with all the essential, affordable and available medicines and these should be taken care by using efficient inventory management techniques. Lacking these brings not only a discredit to the hospital but to the whole public health system as well (Tumwine et al, 2010).

Medicines expenditures should be an issue of concern to the hospital management especially pharmacy managers in ensuring high quality health service provision as far as the health of patients is concerned since most of the time financial resources are limited (Blackburn, 2010). However, there are issues that might bring about increased medicines expenditures such as free market and inflation. The latter is an increase in general price level over time as a result of global economic recession. Another reason could be due to lack of an authority or regulation that deals with controlling prices of medicines especially for private suppliers, bringing about irregular increase of cost and hence expenditures as far as hospital budgets are involved.

Controlling the pharmaceutical expenditures may be done by addressing consumption factors, however analysis of medicines expenditures as part of an assessment of various forms of management interventions is rarely reported since most hospital pharmacy departments especially developing countries such as Tanzania, do not do medicine expenditure analysis; hence creating a research gap.

### **1.1.2 Analysis of medicines expenditures basing on purchasing value (ABC analysis):**

ABC analysis has been found to be effective in the management of pharmaceuticals especially medicines in hospital (Kant et al. 1997). According to Coyle et al, 10% items consume about 70% of the budget (Class A). The next 20% inventory items take away 20% of the financial resources (Class B) and the remaining 70% items account for just 10% of the budget (Class C) (Coyle et al. 2003) This means that the inventories are classified according to the percentage of items and percentage value of annual usage. The term usage refers to the value in money terms of the items purchased. Therefore ABC analysis compares use and cost of items across one particular type of category, which provides information concerning similar medicines and their cost and will project the total cost savings if one medicine is used instead of a more expensive alternative (Table 1).

**Table 1: ABC Analysis of the Classical Study**

	<b>Percentage of items</b>	<b>Percentage value of annual usage</b>	<b>Remarks</b>
<b>Class A</b>	<b>10%</b>	<b>70%</b>	<b>Close day to day control</b>
<b>Class B</b>	<b>20%</b>	<b>20%</b>	<b>Regular review</b>
<b>Class C</b>	<b>70%</b>	<b>10%</b>	<b>Infrequent review</b>

Source: Thawani et al, 2004

The actual and planned purchases comparisons in any medicines supply system is important to know what the planned budget was and what medicines were actually purchased. If all medicines were procured according to the procurement plan or there are some medicines that were purchased but did not appear on the procurement plan and how many items and their cost also how many medicines were on the plan but had not been purchased (MSH/ WHO, 2012).

### **1.1.3 Vital, Essential and Non-essential (VEN) Analysis:**

VEN-analysis is planned to determine priorities of selection and purchasing drugs according to their classification: vital and improving life quality drugs (Vital-V), necessary (Essential-E), secondary (Non-essential-N). The assignment of drugs to the appropriate classes is made by the way of expert evaluation through specific recommendations of physicians and pharmacists (Kolenchic et al. 2007; Rasdorskaya et al. 2008). VEN analysis is very important in ensuring that life saving medicines are available and also helps in cost containment especially by cutting down non-essential medicines which are also known as ‘nice to have’ and concentrating the limited funds to the vital as well as essential medicine.

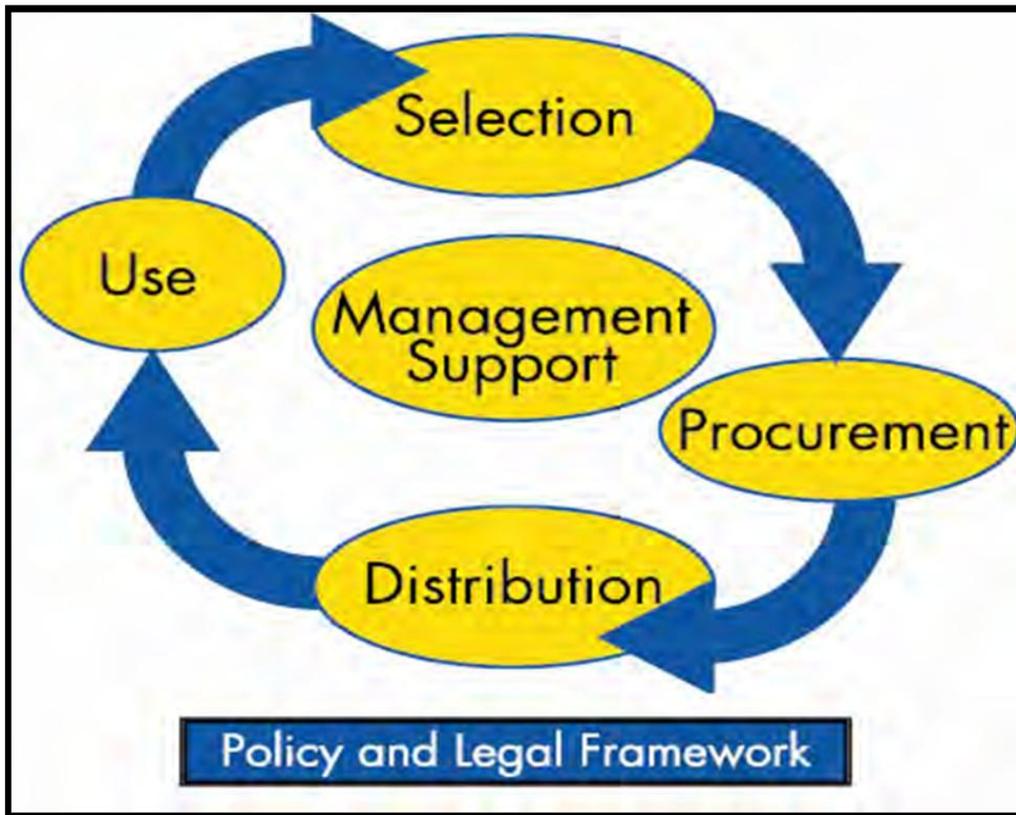
#### **1.1.4 Combined ABC-VEN Analysis**

ABC and VEN analysis systems have a key role in assisting decisions making in medicine selection, purchasing and inventory management and hence help in reducing cost, identifying medicine use problems and improve efficiency in the pharmaceutical supply system (Gupta et al. 2007). Combining ABC and VEN analysis forms a powerful tool for a critical analysis of medicine use and assists in containing the cost especially by restricting the expenditure on non-essential items (Thawani et al. 2004).

#### **1.1.5 Medicine management perspectives**

The key role of Managing Medicine Supply is to ensure that high- quality essential medicines are available at affordable cost according to a given budget, they are well managed or controlled and that they are used rationally (WHO,2007). Managing medicine supply is in short summarized as the 4 basic functions of pharmaceutical management cycle which are selection, procurement (including quantification), inventory management (this also includes storage and distribution) and serving customers/use (MSH/WHO, 1997). This is as shown in Figure 1.

**Figure 1: The logistics cycle for Pharmaceutical Supply Chain Management**



**Source: Management Sciences for Health and World Health Organization. 1997.**

In the context of this research, main concern was on the relation of product selection according to their categories, procurement and inventory control management as explained hereunder:

#### **1.1.4.1 Product Selection**

Product selection is a critical first step in logistics management of medicines. The purpose is to select the most effective and cost-efficient medicines so as to support the goals of a health care system. This should also not compromise the vital and essential medicine items since they have a big role to play in the frame of the quality of health care provided.

#### **1.1.4.2 Quantification and Procurement**

Once the medicines have been selected, the needs must be quantified. Here Quantification is referred to as critical logistics management activity that links the quantities of medicines being used and patient or hospital needs on the ground to financing and procurement decisions. It involves estimating the quantities and the costs of products required to meet customer demand and maintain adequate stock levels in the supply pipeline. Quantification must rely upon accurate, up-to-date information on: service provision and consumption/use of medicines, stock levels and funding sources and amounts for medicines procurement. Procurement is one of the components of the pharmaceutical management which deals with preparation of tendering processes, choice of reliable suppliers and purchasing of medicines so that they are available for use. An effective medicine procurement process ensures the availability of the right medicines in the right quantities, at the reasonable prices, and at recognized standards of quality (MSH/WHO, 1997).

In Tanzania, MSD is the central agency for procurement and distribution of pharmaceutical products to the public health facilities. Therefore procurement of drugs and medical devices at the health facilities is done from MSD and private suppliers or pharmacies. In 2007, assessment of medicine supply study was done in Tanzania, and it was found that 33% of all pharmaceutical procurements in all health centres were procured exclusively from MSD; 45% was done from other sources such as private pharmacies and private pharmaceutical agents (MOHSW, 2008).

#### **1.1.4.2 Pharmaceutical Inventory control management**

Pharmaceutical Inventory Management may be described as the process of managing inventory in order to meet patient demand at the lowest possible cost with minimum investment. It is a very important concept of any pharmaceutical or rather medicine supply chain. Despite several factors concerning pharmacy departments, inventory of medicines can be controlled, and the pharmacy department normally decides how much inventory investment to make, when to reorder and how much, that is in what quantities (Blackburn, 2010).

In hospitals accurate and current stock records are essential for proper inventory management. They are the sources of information used to calculate the needs, and inaccurate records produce inaccurate demand estimations, which bring about problems of stock outs and expiry (Dobler et al, 1996).

The best pharmaceutical management has a great contribution in ensuring essential medicines are available, they are procured at the lowest possible total cost. To achieve the Millennium Development Goals (MDG) means that there should be an increase in pharmaceuticals particularly medicines expenditures; however there is a challenge of limited financial resources. Health institutions especially hospitals in this context have to make sure that a given fund is spent according to the planned budgets and not otherwise. This calls for effective cost analysis of these medicines as well as proper inventory control management.

## **1.2 PROBLEM STATEMENT**

Increasing expenditures on pharmaceuticals is a major concern for healthcare systems worldwide but the situation is more worrying in developing countries because of the scarcity of financial resources (WHO, 2007). Analysis of medicine expenditures in Tanzanian hospitals is rarely reported since most hospital pharmacy departments do not do it as part of the routine annual evaluations. Specifically, it is not well known as to what extent the ABC-VEN approaches are employed in Tanzanian hospitals as part of their pharmaceutical management strategies (Euro Health Group, 2007). Analysis of medicine expenditures has an impact on the inventory management particularly on the type of medicines to be ordered and hence it has the direct impact on the quality of service provided. It also has an effect on the management of financial resources especially on budget allocation.

### **1.3 RESEARCH QUESTIONS**

1. What is the total annual medicines expenditure as a proportion of the total annual hospital expenditure?
2. How are the medicines in the hospital pharmacy department classified with respect to the ABC classification?
3. To what extent is the VEN concept utilized in the procurement of medicines?
4. How are medicines expenditures controlled?
5. How are the actual procured quantities compared against initial quantified estimates for the financial year?
6. What proportion of medicines and their categories require higher supervisory monitoring?
7. What are methods of inventory management used and the challenges involved?

**1.4 RESEARCH OBJECTIVES:**

**1.4.1 BROAD OBJECTIVE:**

To analyze medicines expenditures and pharmaceutical inventory control management at Muhimbili National Hospital.

**1.4.2 SPECIFIC OBJECTIVES WERE:**

1. To determine the annual medicines expenditures using ABC and VEN analysis.
2. To categorize medicines that requires higher inventory control monitoring by using a coupled ABC-VEN Analysis.
3. To compare actual procured quantities of medicine items against ordered or quantified estimates.
4. To explore methods of inventory control management used and the challenges involved.
5. To assess knowledge of the personnel involved in the inventory control management of pharmaceuticals.

## **1.5 RESEARCH RATIONALE**

The results of this study may be used to improvise inventory management system also adds knowledge of categorization and identification of medicine items that consume large part of the budget hence requiring special inventory management as well as on how funds are being spent in procuring medicines so that the principles of good pharmaceuticals procurement strategic objectives are achieved in MNH.

The findings of study will also be useful in proposing areas of improvement in procurement of medicines and its management in relation to purchasing value and importance of medicines. It also suggests measures to facilitate better performance of MNH pharmacy department regarding assessment of plan and priorities on purchasing medicines, increase efficiency in resource use at the hospital and enhance accountability and hence improve quality of health care.

## CHAPTER TWO

### 2. LITERATURE REVIEW

#### 2.1 Global medicines expenditures situation

Average per capita spending on pharmaceuticals in high-income countries was observed to be 100 times higher compared to low-income countries – about US\$ 400 compared with US\$ 4. WHO also estimated that 15% of the world's population consumes over 90% of the world's production of pharmaceuticals and these are people residing in high income countries (WHO, 2004-2007). The report also pointed out that the persistence of unreliable medicines supply systems is one of the main reasons as to why many countries are unable to ensure a regular, sustainable supply of essential medicines. Failures at any point in the supply system can lead to shortages of medicines and avoidable suffering and deaths. In addition, inefficient procurement systems have been found to pay up to twice the global market price for essential medicines and lead to unnecessary waste of funds.

A research done in Greece over the period of 1991-2006 aimed to describe and explain the rise in drug expenditures through decomposition of the increase into the contribution of changes in prices, in volumes and a product-mix effect. The results revealed that real drug spending increased by 285%, despite a 58% decrease in the relative price of pharmaceuticals. The increase in expenditure was mainly attributed by a switch to more innovative, but more expensive, pharmaceuticals, indicated by a product-mix residual of 493% in the decomposition (Lambrelli & O'Donnell, 2011)

A study conducted in a Government medical college hospital in Nagpur, India (Thawani et al, 2004) discovered that the annual medicine expenditure was found to be only 11.59 % of the total hospital budget. Among the objectives of the study was to identify the categories of medicines that need stringent management control. They came out to divide medicine inventory into two priority categories which resulted in identifying the priority I medicines

that needed stringent control. The percentage cost of each medicine helped in determining the economic order quantity and the schedule of placing the purchase orders for medicines of high value amount of money but with low criticality. This study revealed that categorization of medicines by the ABC-VED coupling matrix model may help to narrow down on fewer medicines (Thawani et al, 2004).

Another study was conducted at a 190 bedded service hospital, in India by Gupta et al in 2007. In this study all the drugs expended under section one of the priced vocabularies of medical stores (P V M S) during January to December 2003 were included. Out of 325, 47(14.6%) medicines consumed 70% of ADE (Group A), 73 (22.46 %) consumed 19.99 % of ADE (Group B) and the rest 205(63%) drugs consumed just 9.99 % of the total budget. This study is comparable to other studies conducted at Central Government Health Services (CGHS) stores and Government Hospital, Nagpur, India (Gupta et al, 2007). This study concluded that medicine procurements should be based on proper quantification, taking into account data on actual medicine consumption at each health facility. A system for proper distribution and control of medications in hospital wards/nursing stations and critical care areas should be implemented based on the unit-dose system that relies on actual medication orders for each patient for better management of medicines.

Private pharmacy sector at a multi-specialty hospital in India was studied with the objective of improving its services. The pharmacy was found to use inventory management tools such as ABC and FSN analysis, however tools such as VEN analysis, EOQ and safety stock were found not used. A need for improving the services through utilization of modern management tools was observed. The study revealed that out of total 1,198 items, 104 items fell in 'A' category consumed 70 per cent of total inventory value, 227 items were in 'B' category amounting to 20 per cent of the inventory value and 866 items were in 'C' category with 10 per cent of total inventory value. The VEN analysis of only 'A' category of drugs was carried out, to identify medicines requiring a stricter control. The results of VEN Analysis were as follows; the numbers of vital items were 45, essential 24 and non-essential 35. Among the 35

non-essential drugs, 23 could be restricted to reduce the costs of treatment. These were different brands of statins and their combinations with lipid lowering effect. The study indicated that the quality of services can be improved considerably through good managerial practices.(Kaur et al, 2006)

Another study done in Canada used the ABC-EOQ tool to increase the efficiency of inventory control of a hospital in Saskatchewan. Basing on past year usage of the items, the inventory was classified into A, B and C categories. The economic order quantity (EOQ) was calculated for items in class A, while B and C items were purchased on a min/max basis. Also, a weekly ordering schedule for class A items was developed based on frequency of ordering. The results revealed that the efficiency of the inventory control increased dramatically (50%) after project implementation. Although cost savings were found, they were not substantial compared to previous system (less than \$5,000). Out-of-stock situations for B and C items occurred almost as frequently as before project implementation. This study demonstrated that the EOQ concept in conjunction with ABC inventory analysis using computer was an effective inventory control system in hospital pharmacy. Increased efficiency and cost savings were achieved. Protection against unpredictable demand and avoidance of out-of-stock situations can be achieved by closer adherence to stated ordering procedures for B and C items.(Murphy & Yemen, 1986)

On assessment of pharmacy and inventory control in Ministry of Health hospitals in Jordan revealed that medicines quantification requirements were not estimated according to actual hospital needs and standard procedures. Estimation of medication needs was processed centrally without direct involvement or active contribution of the hospital pharmacists. These are the key stakeholders that must be involved in the selection and quantification of medicines. It was also observed that no hospital had a policy for keeping emergency stock of essential medicines at the time of the survey( Hamza, 2006)

In Thailand hospitals a study was conducted objectively to explore the processes of drug inventory control systems, as well as develop and evaluate the performance indicators of drug inventory control system. A list of drug inventory indicators from literature review was assessed by 20 hospital pharmacists and 9 experts according to the 3 criteria of the good indicators. The second part was a survey of drug inventory process and performance by mailing questionnaires to 720 samples of both public and private hospitals in Thailand. The researchers used Descriptive statistics to explain the process and performance of drug inventory control. This study demonstrated a benchmark of inventory value and provided a thorough understanding of drug inventory processes and their impact on medicine inventory performance. The study results were to serve as a guideline for hospital pharmacists in both the public and private sectors and help them maximize the efficiency of drug inventory systems(Chungsiwapornpong, 2007).

Economic analysis plays a pivotal role in the management of medical store. This was revealed by a study done in a Tertiary Care Hospital in Central India. The main objectives of this study were to consider an (ABC-VED) analysis with economic order quantity (EOQ), comparison of indexed cost and the actual cost, and to assess the expenditure for the forthcoming years. Based on cost and criticality, a matrix of nine groups by combining ABC and VED analysis was formulated. Drug categories were narrowed down for prioritization to direct supervisory monitoring. The subgroups AE and AV of categories I and II should be ordered based on EOQ. The difference between the actual annual drug expenditure (ADE) and the derived indexed cost using the cost inflation index (CII) was calculated. Linear regression was used to assess the expenditure for the forth coming years. The total ADE for the financial year of 2010–2011 was Rs. 19,144,253 which was only 7.68% of annual hospital expenditure. Using the inflation index, the indexed cost of acquisition of ADE for year 2010–2011 was Rs. 19,510,387. The difference between the two was estimated to be 2.11%. Thus, the CII justified the demand of increased budget for next year and prompted stakeholders for cautious use of medicines. By taking into consideration the ADE of last 10 years, the budget for forthcoming

years was forecasted. This is a helpful concept significantly for making policies according to the available budget.

The findings of the above study basing on the inventory management side were as follows; ABC-VED analysis identified medicines requiring stringent control for the optimal use of resources. Due to inflation, total expenditure for the medicine was found to increase each year, this supported the higher budgetary requirement for the forthcoming years. At the same time, forecasting of budget was found to be helpful for better management of medical store. Hence, ABC-VED along with EOQ and integrated economic analysis optimizes the costs of medicare services besides making materials available to the patients which can increase the quality of healthcare services.(Mahatme et al, 2012)

Computerization improves pharmaceutical purchasing and inventory control systems, a study was done and a method by which a pharmacy department could improve its purchasing and inventory control system was described. This was through a system changing to the computerized inventory control system. Pharmacy department maintained the decision-making authority over all vendors and dosage forms of medicinal products. Optimal results were achieved when the purchasing department's pharmacy buyer position was staffed with an employee who had previous experience as a clerical worker in the pharmacy. According to the authors it was observed that this system has proved to be an effective, cost efficient method of purchasing and inventory control of pharmaceuticals in their hospital (Rubin & Keller, 1983)

Pharmaceutical purchasing and inventory control requires a quality assurance program so as to ensure that quality medicines are purchased at the lowest price, products are available when needed, the system is managed efficiently and that there is internal controls provided. To meet these objectives, product quality, vendor performance, the department's system of internal controls, purchasing data, and storage conditions should be monitored. A checklist for evaluating purchasing and inventory practices and a sample audit form listing quality assurance criteria, standards, procedures, and recommended actions should be provided. A

quality assurance program for pharmaceutical purchasing and inventory control should define institution-specific criteria and standards and use these standards for continual evaluation of all aspects of the purchasing and inventory control system. Documentation of quality assurance activities should be provided for use by the purchasing department, hospital administration, and regulatory bodies (Soares, 1985).

For better medication distribution and pharmacy services management numerous models are used. This was observed since the year 2003, the University Of Rhode Island College Of Pharmacy and the Rhode Island Department of Corrections (RIDOC) collaborated on a pharmacy management program designed to better integrate medical care, improve medication utilization, and reduce pharmaceuticals costs. RIDOC pharmaceutical expenditures grew at a rate of approximately 1.5% per inmate per Year from 2003 to 2009, considerably below the annual pharmaceutical inflation rate. The analyses of projected and actual medicine spending indicated that RIDOC benefited from savings of almost \$5 million during this period. Another important thing was a provision of educational opportunities for doctor of pharmacy students in this practice setting concerning cost containment and inventory management (Marcoux et al, 2012).

## **2.2 Medicines expenditures and inventory management in Tanzania**

In general, the main sources of funding for the health sector in Tanzania is the Government of Tanzania (GoT), the Global Fund (GF) and other development partners, where expenditure for medicines and medical supplies accounts for more than a third of the total health budget. In 2006 - 2007 the GoT contributed 53% and development partners, including the Global Fund, contributed 47% (URT 2008). Although Tanzania has made significant progress in recent years and medicines for all the vertical programs are available, consistent availability of other medicines and supplies in health facilities remains a challenge. The government has irregularly and insufficiently funded MSD which affects MSD's ability to procure sufficient volumes on a timely basis. This has an implication on procurement of medicines for health

facilities as they have to procure most of the items from local suppliers which increase the expenditures since most of the time they are sold at higher prices (MOHSW, 2010).

The Health Expenditure per capita in Tanzania was reported as USD 30.91 in 2010. Total health expenditure is the sum of public and private health expenditures as a ratio of total population. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation (World Bank, 2012)

The 2011/2012 MoHSW budget shows that the GoT's contribution in health sector especially medicines budget has decreased to 39%, whereas the development partners' contribution has increased to 61% (SIKIKI, 2011). A report by the Ministry of Health and Social Welfare showed that there were more areas in the health facilities management systems that required improvement. This was in comparison with how the supply chain management was managed in the regional, central and national levels. It was also revealed that there were challenges regarding to the quantification processes and staff interviewed did not have a unified system for determining what to order from the Central Store (MOHSW, 2008)

The 2010/11 report of the Controller and Auditor General (CAG) in Tanzania uncovered a series of shortcomings which point to failings in the procurement and distribution system. The report showed that 8 billion Tanzanian shillings worth of medicines had expired within MSD stores while at the same time facilities were experiencing shortages of key medicines. MSD records indicated that they had 5.2 billion Tanzanian shillings worth of stock at hand, a figure that was later revised to 151 million Tanzanian shillings, a significant variation from original figure. This is a challenge to our developing country since we have limited funds to spend on medicines and therefore it calls for cost conscious expending on medicines and effective inventory management as per our economy perspectives ([http p://in2eastafrika.net/msd-drugs-worth-8bn-spoiled/print/](http://in2eastafrika.net/msd-drugs-worth-8bn-spoiled/print/)).

The logistic skills levels of personnel involved in medicines supply as well as inventory management of medicines in public hospitals was assessed by Kagashe et al, 2011 in Dar es Salaam region, Tanzania. They observed a need for the supply of medicines to be managed efficiently in order to prevent all types of wastage including overstocking, pilferage and expiry. This wastage may influence the quality of health care provided to patients. Problems of stock outs or overstocking and expiry of medicines in public hospitals were reported. Their results also revealed that logistic skill level was poor and inventories were not well managed. Lack of funds and poor logistic skills contributed to stock outs. They recommended that personnel dealing with medicines supply should be trained in procurement and inventory management (Kagashe & Massawe, 2012).

## **CHAPTER THREE**

### **3.0 RESEARCH METHODOLOGY:**

#### **3.1 Study design:**

A hospital based cross-sectional study was conducted by using quantitative and qualitative data collection methods to analyze the annual medicine expenditures and to explore the pharmaceutical inventory control management.

#### **3.2 Study period:**

The study was conducted between April and May 2013, followed by report writing from June to July 2013.

#### **3.3 Study area:**

The study was conducted at Muhimbili National Hospital (MNH) which is a national referral hospital and a university teaching hospital located in Dar-es-salaam, Tanzania. Dar-es-salaam region is the commercial capital of Tanzania. MNH is a 900 bed capacity hospital and receive about 1000-1200 out-patients per day. Also about 1000-1200 patients are admitted per day. Being a public hospital, it receives a large portion of its budget from the government and the rest is generated through out- of-pocket payment and reimbursement largely from the National Health Insurance Fund (MNH, 2013).

#### **3.4 Sampling of participants for qualitative data:**

A purposive sampling technique was used because of the small number of the pharmaceutical personnel. Therefore all pharmaceutical health workers available during the study period were involved.

A total of 35 pharmaceutical personnel gave their consents to participate in the study and were therefore interviewed so as to explore the challenges involved in inventory management at the hospital and also to assess their knowledge about inventory management. 21 participants were intern pharmacist, 8 pharmacists and 6 pharmaceutical technicians.

### **3.5 Data collection tools:**

Data was collected by using pre-tested semi-structured questionnaires and through document reviews.

#### **3.5.1 Document review:**

This was done by reviewing the hospital's electronic database system known as JEEVA. Other key documents reviewed include the annual hospital detailed budget report, purchase order register and Goods Receiving Notes (GRN) of the medicine items procured in the studied financial year.

#### **3.5.2 Semi-structured questionnaire:**

Self administered questionnaire which contained closed-ended and open-ended questions were used for gathering information from the pharmaceutical personnel. These questions were designed to assess knowledge of pharmaceutical personnel regarding important concepts of medicine inventory management system. Open ended questions were used to elicit experiences about inventory system that exist in the hospital. In the questionnaire the respondents were also asked about application of ABC and VEN. Apart from demographic data questions, a zero (0) point was given for an incorrect answer and one (1) point was given for the correct answer. The levels of knowledge were graded as poor (0-49%), average (50-74%) and good (75-100%). Criteria used for ranking these levels were: when someone scored less or equal to 5 questions ranked to be of poor knowledge, on answering correctly greater than 5 to less or equal to 8 questions designated as having average knowledge and lastly, on responding correctly to greater than 8 to 12 questions designated to have a good knowledge. The questionnaire is attached as Annex I

### **3.6 Study Variables:**

Quantitative and qualitative data were collected by using the tools. Specifically the following information was of interest to this study:

- Proportion of total annual medicines expenditures as per total annual hospital expenditures.
- Proportions of medicine items categorized as Class A, B and C as per ABC analysis.
- Proportions of budget costed by Class A, B and C items.
- Proportions of medicine items categorized as vital, essential and non-essential medicines as per VEN analysis.
- Proportions of budget estimated by the vital, essential and non-essential items.
- Proportions of the items designated as Category I, II and III of the coupled ABC-VEN matrix.
- Comparison of actual procured quantities of medicine items against ordered estimates.
- Methods of inventory control management used and the challenges involved.
- Knowledge of pharmaceutical personnel involved in inventory control management of pharmaceuticals.

### **3.7 Data collection procedure and data analysis**

#### **3.7.1 Quantitative data**

Analysis of the quantitative data was done by using Microsoft Excel<sup>®</sup> spreadsheets.

##### **(a) The ABC analysis :**

The process of analysis was done through the following steps;

1. All the items procured in the financial year which started from 1<sup>st</sup> July 2011 to 30<sup>th</sup> June 2012 were extracted from the hospital electronic database, checked and edited for any inconsistency. This applied for all medicine items so as to avoid any invalid comparisons
2. The unit cost for each medicine and the total quantities received were used to calculate the value of each item. For the same items but procured from different local suppliers with different unit costs, an average unit cost of those items was calculated.
3. The value of consumption was furthermore calculated; by multiplying the unit cost by the number of units of each medicine purchased to obtain the total value.
4. Then the percentage of total value represented by each medicine was also calculated; by dividing the value of each medicine to the total value of all medicines. The results for each item was entered under the heading `percent of total value`
5. The list was then rearranged; the items or rather medicines were ranked in descending order by total value, starting at the top with the highest value. This also yielded a list that is also ordered by percentage of value
6. Cumulative percentage of total value for each medicine was calculated; starting with the first item at the top, adding the percentages up to the last item. These steps are summarized in the table below:

**Table 2; Steps for conducting ABC Analysis (Step 1-6)**

Item no;	Medicine description	Basic unit	Unit cost	Total units	Value(Tshs)	% Total value	Cumulated % of value
1.							
2.							

7. Cut-off points or boundaries for Class A, B and C medicines were chosen;

Using Thawani et al study, items were classified as follows: items that had highest annual usage, with only about 10% of the items that costed about 70% of the total utilized medicine budget were classified as Class A items. Class B items were those that accounted for approximately 20% of the items and used about 20% of the funds. Lastly the Class C items; these accounted approximately 70% of the items but used only 10% of the budget (Thawani et al, 2004)

8. Lastly the results were presented into tables showing proportions of items in different classes and the proportion of budget utilized.

**(b) The Vital, Essential, Non-essential(VEN) analysis:**

The same medicines were further subjected to VEN analysis; this was based on the criticality need of the medicine to the health priorities of the patients. The VEN status of each medicine was discussed with pharmacist in-charge of the central main store and pharmacist in-charge of one block. For the MSD procured items, MSD price catalogue list was used, this has categorized all their medicines as vital essential and non-essential. For the case of local supplied medicines, a discussion was done with the pharmacists till a consensus was reached hence all the medicines that are found in the hospital pharmacy department were categorized as the Vital, Essential or Non-essential items based on the critical demand for survival of the

patients. The proportions of the medicines in each of these categories were computed together with their respective percentage budget.

**(c) Coupling of ABC-VEN analysis**

ABC and VEN analyses were coupled or rather combined by cross-tabulation to get an ABC-VEN matrix that was used to get the different categories of medicines that (Table 3)

**Table 3: How to obtain the ABC-VEN Matrix**

	Vital	Essential	Non-essential
<b>Class A</b>	AV	AE	AN
<b>Class B</b>	BV	BE	BN
<b>Class C</b>	CV	CE	CN

- *The first alphabet represent the medicine's place in the ABC analysis*
- *The second one stands for its place in the VEN analysis*

ABC-VEN matrix resulted into a total of 9 sub-categories were as shown from the table and from this coupled ABC-VEN matrix, 3 categories were obtained as follows:

Category I comprised of all the expensive and vital medicine items, as follows:  
 $AV+AE+AN+BV+CV$

Category II included the remainder of the items in B and E items, such that:  
 $BE+BN+CE$

Category III included the cheapest and non-essential medicine items: CN

**(d) Comparison of the estimated quantity of medicines to the actual procured quantities of medicines for the financial year**

This was done by using MS Excel spreadsheets where the total quantity requested or ordered for each medicine item (obtained from the GRN document) and the quantity received were computed according to their VEN categorization. The results obtained were presented in the tables.

**3.7.2 Qualitative data:**

Through self administration of semi structured questionnaires, qualitative data were collected, just like described on the tools. Data were entered, cleaned, coded and analyzed using Statistical Package for Social Sciences (SPSS) version 20.0 software. Results were summarized using table and figure

**3.8 Ethical considerations:**

Ethical clearance for this study was obtained from the Institutional Review Board of the Muhimbili University of Health and Allied Sciences (MUHAS). A letter of permission to conduct the study was obtained from the hospital administration and hence permitted to access the essential documents for the study. Study participants were also asked for informed consent before interview. In this process, they were given a consent form to read and sign if they agreed to participate in the study. Data were kept confidential by the investigator.

A consent form is attached as Annex no. II

## CHAPTER FOUR

### 4.0 RESULTS

#### 4.1 Annual medicines expenditures

##### (a) The overall summary of the hospital medicines expenditures

In the studied financial year, the hospital detailed budget report showed that the planned budget for medicines and other medical supplies was Tshs. 2.1 billion (approximately 1.3 million USD) while the actual budget utilized was Tshs. 2.32 billion (around 1.5 million USD). The total annual hospital expenditures were about TZS billion 92 where as the annual medicines expenditures were TZS billion 1.2 (approximately 750,000 USD) making the proportion to be 1.3%. At the time of analysis the exchange rate was TZS 1600 per 1 USD.

Table 4 and 5 shows the annual total medicine expenditures analysed by annual usage (here referred to as ABC analysis) about 46(11.7%) costed 69.5%, 69(17.5%) costed about 20.5% whereas majority (70.8%) only consumed 10% of the total medicine expenditures.

**Table 4: Summary of medicines expenditures by ABC classification**

Medicine analysis	Class A	Class B	Class C	Total
<b>No. of items (%)</b>	46(11.7%)	69(17.5%)	279(70.8%)	394(100%)
<b>Annual Purchasing value in millions TZS (%)</b>	831.2(69.5%)	245(20.5%)	120.3(10.0%)	1196.5(100%)

**Table 5: Summary of medicines expenditures by VEN classification**

<b>Medicine analysis</b>	<b>Vital items</b>	<b>Essential items</b>	<b>Non-essential items</b>	<b>Total</b>
<b>No. of items (%)</b>	67(17.0%)	270(68.5%)	57(14.5%)	394(100%)
<b>Annual Purchasing value in millions TZS (%)</b>	306.6(25.6%)	846.5(70.7%)	43.5(3.7%)	1196.5(100%)

**(a) Medicines expenditures according to ABC classification for MSD and local suppliers procured items**

**(i) Items purchased from MSD**

As per annual medicine usage using ABC analysis, the findings shows that out of 143 medicine items were procured from MSD, 15(10.5%) items belonged to Class A, 26(18.2%) items as Class B and 102(71.2%) belonged to Class C. These medicine items consumed 69.31%, 20.67% and 10.02% of the money spent on procuring medicines from MSD for Class A, B and C respectively. All these items costed about TZS 771 million.(Table 6).

**Table 6: ABC analysis of medicine items procured from MSD**

<b>Category</b>	<b>No. of items</b>	<b>% of items (n=143)</b>	<b>Budget in TZS</b>	<b>% of the Budget</b>
<b>Class A</b>	15	10.5	534,507,980	69.3
<b>Class B</b>	26	18.2	159,376,636	20.7
<b>Class C</b>	102	71.3	77,305,700	10.0
<b>Total</b>	143	100.0	771,190,316	100.0

## (ii) Items procured from Local Suppliers

A total of 251 medicine items were procured from local suppliers. ABC analysis shows that, 31(12.4%) medicine items were found to be Class A, while Class B had 43(17.1%) items whereas Class C consisted of the remaining 177(70.5%) medicine items. These costed 70%, 20% and 10% of the annual budget spent on procuring medicines from local suppliers correspondingly, which was about TZS 425 million (Table 7).

**Table 7: ABC analysis of the medicine items procured from Local suppliers**

Category	No. of items	% of items (n=251)	Budget in TZS	% of the Budget spent
<b>Class A</b>	31	12.4	296,716,979	70.0
<b>Class B</b>	43	17.1	85,647,943	20.0
<b>Class C</b>	177	70.5	43,020,202	10.0
<b>Total</b>	251	100.0	425,385,124	100.0

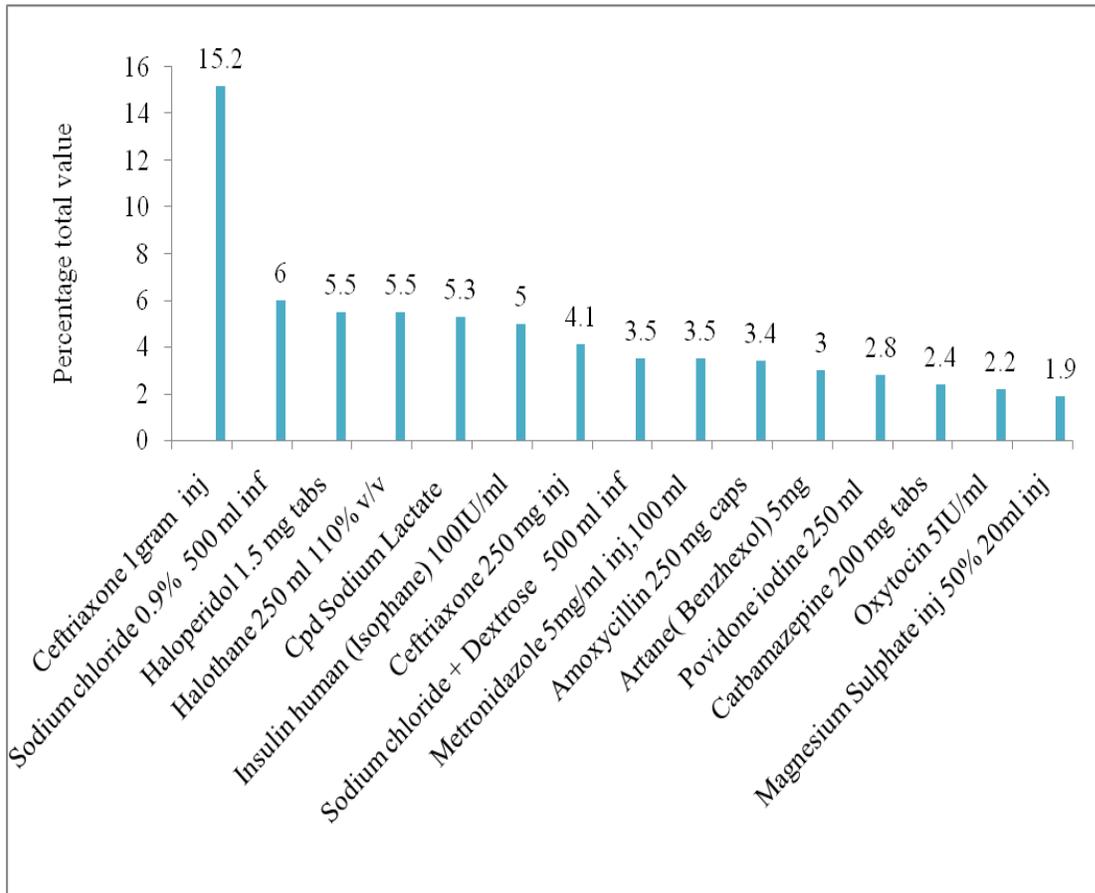
Class A medicine items were observed to be of an interest since they consumed large part of the budget and therefore the study went further on looking at the composition of the class. The findings show that 8 out of the 15 Class A items from MSD procured items consumed about 50% of the budget. Ceftriaxone 1 gram injection had a percentage total value of 15.2, Sodium chloride 0.9% 500ml infusion used 6% whereas haloperidol 1.5 mg tabs and halothane 250 ml 110% v/v had the same percentage total value of 5.5. Magnesium sulphate injection had a percentage total value of 1.9(Figure 2)

For the local suppliers procured medicines, 14 out of 251 items consumed about 50% of the budget and Meloxicam and Augmentin tablets had percentage total value of 16. Out of the Class A local suppliers procured items, Meloxicam, Augmentin 625 tabs, Glimepiride 1mg

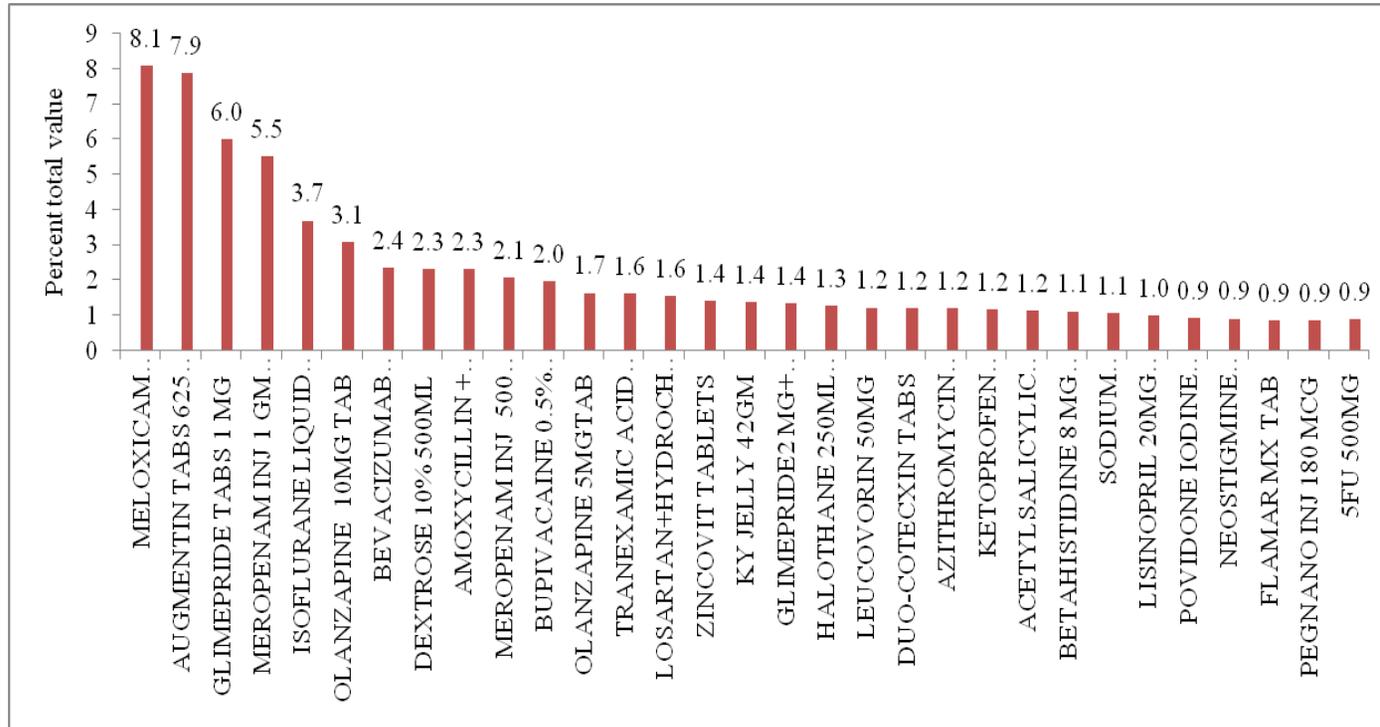
tabs, Meropenam injection and Isoflurane Liquid had percentage total values of 8.1, 7.9, 6.0, 5.5, and 3.7 respectively(Figure 3)

Figure 2 and 3 show the percentage total value of class A individual medicines procured from MSD and Local Suppliers respectively.

**Figure 2: Percentage total value of the 15 Class A medicine items procured from MSD**



**Figure 3: Percentage total value of the 31 Class A medicine items procured from local suppliers**



**(b) Medicines expenditures according to Vital, Essential and Non-essential (VEN) classification for MSD and local suppliers procured items**

VEN analysis is the one that categorizes medicines according to their criticality as far as priority and importance to the patient's health care is concerned.

**(i) Items procured from Medical Store Department**

On performing VEN analysis, the findings revealed that 50(35%) of the items were vital, 90(63%) grouped as essential and only 3(2%) of the items as the non-essential medicines. It was interesting to observe that the essential medicines utilized most of the budget (69.40%) and non-essential ones using only 0.20% of the budget. The budget here is the amount of money spent on MSD items which was about TZS 771 million. (Table 8)

**Table 8: VEN analysis of the medicine items procured from MSD**

<b>Category</b>	<b>No. of items</b>	<b>% of items(n=143)</b>	<b>of Budget in TZS</b>	<b>% of budget</b>
<b>Vital</b>	50	35.0	234,478,420	30.4
<b>Essential</b>	90	63.0	535,251,896	69.4
<b>Non-essential</b>	3	2.0	1,460,000	0.2
<b>Total</b>	143	100	771,190,316	100

**(ii) Items procured from Local Suppliers**

For the explored local supplied items, 17(6.8%) of the items were Vital whereas 180(71.7%) categorized as Essential and 54(21.5%) grouped as Non-essential medicines. There was also a similar observation just like it was found in the MSD procured items; most of the budget being consumed by the essential medicines. Budget used was about TZS 425 million for medicines from local suppliers. (Table 9)

**Table 9: VEN analysis of the medicine items procured from local suppliers**

<b>Category</b>	<b>No. of items</b>	<b>% of items(n=251)</b>	<b>Budget in TZS</b>	<b>% of budget</b>
<b>Vital</b>	17	6.8	72,129,970	17.0
<b>Essential</b>	180	71.7	311,217,911	73.0
<b>Non-essential</b>	54	21.5	42,037,243	10.0
<b>Total</b>	251	100	425,385,125	100

## 4.2 Medicines that require higher inventory control monitoring

### (a) MSD procured items

Our findings shows that out of MSD procured medicines only 4(26.67%) of the items were vital and belonged to Class A (AV). There was no vital or essential medicines that belonged to Class C and most of non-essential medicines belonged to Class B, 65(63.73%) as it appears in Table 10.

**Table 10: ABC-VEN coupled matrix of medicine items procured from MSD (n=143)**

	Vital		Essential		Non-essential		Total	
<b>Class A</b>	4	(26.7%)	12	(46.2%)	34	(33.3%)	50	(35.0%)
<b>Class B</b>	11	(73.3%)	14	(53.6%)	65	(63.7%)	90	(63.0%)
<b>Class C</b>	0	(0.0%)	0	(0.0%)	3	(3.0%)	3	(2.0%)
<b>Total</b>	15	(100%)	26	(100%)	102	(100%)	<b>143</b>	<b>(100%)</b>

**(b) Local suppliers procured medicines**

For the case of local procured medicines, it was interesting to find that more than half of the vital, essential and non-essential medicines were lowest cost items belonging to Class C. (Table 11)

**Table 11: ABC-VEN Coupled matrix of medicine items procured from Local Suppliers (n=251)**

	<b>Vital</b>		<b>Essential</b>		<b>Non-essential</b>		<b>Total</b>	
<b>Class A</b>	6	(35.3%)	22	(12.2%)	3	(5.6%)	31	(12.4%)
<b>Class B</b>	2	(11.8%)	33	(18.3%)	8	(14.8%)	43	(17.1%)
<b>Class C</b>	9	(52.9%)	125	(69.5%)	43	(79.6%)	177	(70.5%)
<b>Total</b>	17	(100%)	180	(100%)	54	(100%)	<b>251</b>	<b>(100%)</b>

**(c) Items Requiring Different Inventory Control**

From the ABC-VEN coupled matrix, the study explored 3 categories that would require different inventory control management as depicted in Table 12 and 13 for items purchased from MSD and local suppliers respectively

**Table 12: Prioritization categories of the medicines procured medicines (n=143)**

	V	No. of items	E	No. of items	N	No. of items	Total medicine items
<b>A</b>	AV	4	AE	12	AN	34	50
<b>B</b>	BV	11	BE	14	BN	65	90
<b>C</b>	CV	0	CE	0	CN	3	3
<b>Total</b>		15		26		102	143

Category I medicines: AV, AE, AN, BV and CV making a total of 61(42.7%) items

Category II medicines: BE, CE and BN making a total of 79(55.2%) items

Category III medicines: CN having 3(2.1%) items

**Table 13: Prioritization categories of the medicines procured from Local Suppliers (n=251)**

	V	No. of items	E	No. of items	N	No. of items	Total medicine items
<b>A</b>	AV	6	AE	22	AN	3	31
<b>B</b>	BV	2	BE	33	BN	8	43
<b>C</b>	CV	9	CE	125	CN	43	177
<b>Total</b>		17		180		54	251

Category I medicines: AV, AE, AN, BV and CV comprised of 42(16.7%) items

Category II medicines: BE, CE and BN had a total of 166(66.1%) items

Category III medicines: CN had 43(17.2%) items

Furthermore, the obtained ABC-VEN matrix of our study was compared to other studies done in different hospitals in India, as shown in Table 14.

**Table 14: The ABC-VEN matrix of the present study compared to others**

Category	Present study(MNH)		GMCH Nagpur study	CGHS study
	(MSD)	L/S		
	n=143	n=251	n=223	n=190
<b>A</b>	10.45	12.40	10.76	17.81
<b>B</b>	18.18	17.10	20.63	22.60
<b>C</b>	71.33	70.50	68.61	59.59
<b>V</b>	34.97	6.80	23.76	5.14
<b>E</b>	62.94	71.70	38.12	58.90
<b>N</b>	2.10	21.50	38.12	35.96
<b>I</b>	42.66	16.73	29.15	21.58
<b>II</b>	55.24	66.14	41.26	56.16
<b>III</b>	2.10	17.13	29.59	22.26

Note: The figures above are in percentage (%). GMCH is a short form of Government Medical College and Hospital; India, CGHS stands for Central Government Health Services of India. MSD for Medical Store Department and L/S for Local Suppliers; MNH for Muhimbili National Hospital, Tanzania.

### 4.3 Comparison of the estimated ordered quantity of medicines to the actual procured quantities of medicines for the financial year 2011/2012

The quantities of the actual procured medicines and the estimated ordered items are compared. The findings show that of the total consignment ordered from MSD, only 39(27.3%) of the items were received as ordered whereas more than half, 98(68.5%) of the items was received less than what was ordered. However 6(4.2%) of the items were received more than the quantity ordered (Table 15).

**Table 15: Percentage of items ordered and received from MSD**

	No. of items (n=143)	% of items
<b>Ordered and received same quantity</b>	39	27.3
<b>Ordered and received less quantity</b>	98	68.5
<b>Ordered and received more quantity</b>	6	4.2
<b>Total</b>	143	100.0

Moreover majority of the items (65.3%)procured from the local suppliers were received less than the quantity ordered while 33.9% of the items of the order requested were the same as that procured (Table 16)

**Table 16: Percentage of items ordered and received from Local Suppliers**

	No. of items (n=251)	% of items
<b>Ordered and received same quantity</b>	85	33.9
<b>Ordered and received less quantity</b>	164	65.3
<b>Ordered and received more quantity</b>	2	0.8
<b>Total</b>	251	100.0

Further, the results reveals that out of 50 vital medicine items that were procured in the financial year 2011/2012 from MSD, it is only 13(26%) items that were procured and received exactly as ordered. About 34 items (68%) of the vital medicine items were received less as compared to the quantity ordered. Most of the essential medicines (70%) were received less than the quantity ordered. Only 3 items (6%) were received more than the quantity ordered (Table 17).

**Table 17: Percentage of items ordered and received from MSD according to VEN categorization (n=143)**

	Vital	Essential	Non-essential	Total
<b>Ordered and received same quantity</b>	13(26.0%)	4 (26.7%)	2 (66.7%)	39 (27.3%)
<b>Ordered and received less quantity</b>	34 (68.0%)	63 (70.0%)	1 (33.3%)	98 (68.5%)
<b>Ordered and received more quantity</b>	3 (6.0%)	3 (3.3%)	0 (0.0%)	6 (4.2%)
<b>Total</b>	50 (100%)	90(100%)	3 (100%)	<b>143 (100%)</b>

The results also shows that majority (70.6%) of the Vital items procured from local suppliers were received as ordered as shown in Table 18.

**Table 18: Percentage of items ordered and received from Local Suppliers according to VEN categorization (n=251)**

	Vital	Essential	Non-essential	Total
<b>Ordered and received same quantity</b>	12(70.6%)	117 (65.0%)	35 (64.8%)	164 (65.3%)
<b>Ordered and received less quantity</b>	5(29.4%)	61 (33.9%)	19 (35.2%)	85 (33.9%)
<b>Ordered and received more quantity</b>	0 (0.0%)	2 (1.1%)	0 (0.0%)	2 (0.8%)
<b>Total</b>	17(100%)	180(100%)	54 (100%)	<b>251(100%)</b>

#### 4.4 Methods of inventory control management used and the challenges involved

The methods of inventory control used by the hospital were explored. The MNH pharmacy department uses a computerized, electronic drug record system (EDRS) equipped with JEEVA software. The system is designed such that different reports can be obtained, such as the daily dispensed items and quantities. The sub-pharmacies order their needs from the central main pharmacy and issue their medicines through this system. However the pharmaceutical personnel have to fill the bin cards of the respective pharmaceuticals which imply that physical inventory has to reconcile with the computer system as well as the bin-cards at the end.

### **Challenges involved in inventory management as reported by the pharmaceutical personnel**

The study explored the challenges involved in inventory management by pharmaceutical personnel; Results show that 94% of the interviewed pharmaceutical personnel, complained about the shortage of staff, 54.5% saw a problem with electric power on and off. The other challenges are as shown in Table 19.

**Table 19: Challenges encountered in inventory management (n=33)**

<b>Challenges</b>	<b>No. of respondents (%)</b>
<b>Shortage of staff</b>	31(94.0)
<b>Electric/power on and off</b>	18(54.5)
<b>Network failure/server down</b>	13(39.4)
<b>Errors using EDRS/ poor documentation</b>	10(30.0)
<b>Small space capacity</b>	15(45.4)
<b>A/c and fans not enough/ not working</b>	11(33.3)
<b>Lack of seminars</b>	16(48.5)

#### 4.5 Knowledge of the personnel involved in the pharmaceutical inventory control management

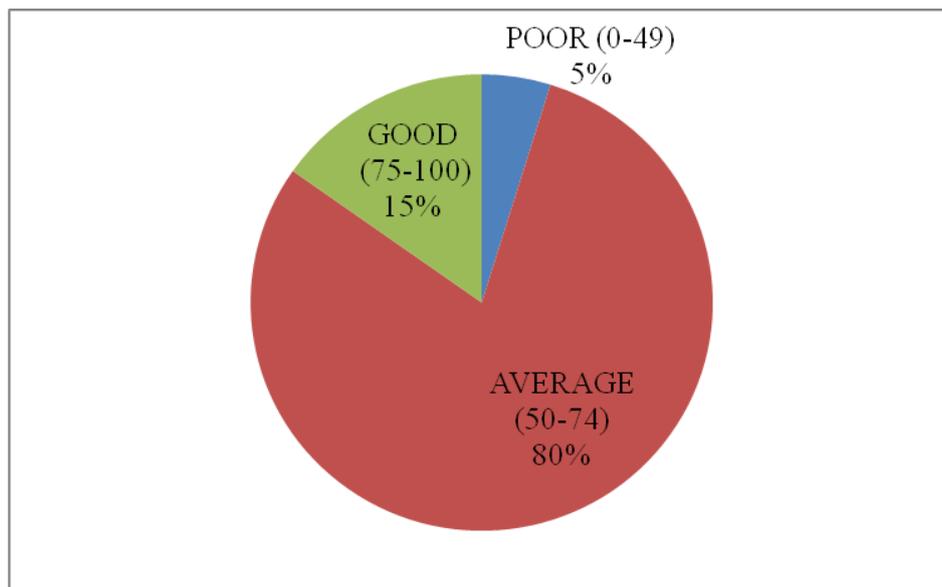
Knowledge of the pharmaceutical personnel involved in inventory control of pharmaceuticals was solicited. Majority were pharmacy degree holders with intern pharmacists being 60%. This is as shown in Table 20.

**Table 20: Socio- demographic characteristics of pharmaceutical personnel (n= 35)**

Characteristics		No. of participants	Percentage
<b>Sex</b>	Male	18	51.4
	Female	17	48.6
<b>Age (years)</b>	<29 years	16	45.7
	30-49 years	12	34.3
	50+ years	7	20.0
<b>Education</b>	Diploma	6	17.1
	Degree	29	82.9
<b>Occupation</b>	Pharm technicians	6	17.1
	Intern pharmacists	21	60.0
	Pharmacists	8	22.9
<b>Working experience</b>	< 1 year	21	60.0
	1-5 years	6	17.1
	5+ years	8	22.9

The respondents were asked whether they knew about different concepts used in inventory management such as economic order quantity, safety stock and review period. Majority (63.0%) knew about those concepts involved in inventory management and that they had learned from on-job training. A big proportion (70.0%) also knew the purpose of medicine inventory management. However most of the intern pharmacists' respondents (85.7%) could not correctly explain the application of Vital, Essential and Non-essential analysis as far as inventory management is concerned. They were also asked whether they knew about the methods of inventory control, most (65.8%) responded to know however on being asked to mention at least one method of it, majority (70.4%) could not correctly mention the methods used in inventory control. The knowledge level was ranked as poor, average and good on scoring 0%-49%, 50%-74% and 75%-100% respectively. Majority (80.0%) had an average knowledge level. (Figure 4)

**Figure 4: Knowledge rank of pharmaceutical personnel on inventory management (n=35)**



## CHAPTER FIVE

### 5.0 DISCUSSION

#### 5.1 Muhimbili National Hospital's medicines expenditures

Analysis of medicine expenditures for the financial year 2011/2012 involved a total of 394 medicine items where 143 items were procured from MSD and the rest 251 medicine items were purchased from local suppliers. MSD is a government agency and its medicine prices are usually low compared to those of local suppliers, hence the fact that nearly two-thirds of the medicines are procured from local suppliers who sells at higher prices is very surprising and can explain high expenditures on medicines at this hospital. According to the year 2010 report on Tanzania health system assessment, it was revealed that Tanzania has made significant progress in recent years on ensuring that medicines for all the vertical programs are available. However consistent availability of other medicines and supplies in health facilities remains a challenge. This could be explained by irregular and insufficient funding by the government which affect the MSD's ability to procure sufficient volumes of products and at the required time (MOHSW, 2010). Consequently this has an implication on procurement of medicines for the hospital as it has to procure most of the items from local suppliers.

The proportion of the annual medicines expenditures to the total recurrent costs was very low (1.3%) compared to other studies such as Mahatme et al, 2012 which was about 7.7% and Thawani et al, 2003 which was about 11.6%. These two studies have been done in India. The difference could be due to different specialty services provided. The study by Thawani was conducted in a 1400 bedded hospital in India whereas MNH has only 900 beds.

## 5.2 The Class A, B and C medicines (ABC Analysis)

The ABC analysis show that only about 10.5% of the medicine items belonged to Class A and they consumed about TZS 69.3% of the money spent on medicines. About 26(18.2%) medicine items categorized as Class B had a purchase value of Tshs. 159 million which is 20.7% of the money spent on medicines. The rest of the items, that is, about 102(71.3%) items costed about Tshs. 77 million which is about 10.0% of the money spent on medicine categorized as Class C. This type of analysis is based on the inventory application of what is known as Pareto principle, also referred as a Classical study which according to Gupta et al, 2007; Class A items may contain only about 10% of total inventory items, but cost about 70% of the total money value. Class B consist 20% of total inventory items, and consuming about 20% of the total money value. The last Class C items may represent about 70% of total inventory items, but just uses about 10% of the total money value. Other studies by Manhas et al 2012, Vaz et al 2008, and Thawani et al 2003, observed the similar results as the present study where about 70% of the budget was consumed by class A medicines.

Coyle et al (2003) observed that 10% items consume about 70% of the budget (Class A). The next 20% inventory items take away 20% of the financial resources (Class B) and the remaining 70% items account for just 10% of the budget (Class C). Their findings are in line with the present study, implying that the Class A items being few but expensive require a close day to day control. With regard to class B and class C, these need a regular and infrequent review respectively.

The findings of this study can also be related to another study conducted at hospital in India by Gupta et al, 2007. They found that out of 325, 47(14.6%) medicines consumed 70% of ADE (Group A), 73 (22.46 %) utilized 19.99 % of ADE (Group B) and the rest 205(63%) drugs consumed just 9.99 % of the total budget. These findings insist on close supervision of the Class A items as the heart of the percentage value of medicine expenditures for medicine budget fall. If these items are not properly managed in terms of selection, procurement and inventory management, there will be a raise in expenditures which will affect the pharmaceutical services provided by the hospital. Furthermore these study findings are also supported by another study conducted at Central Government

Health Services (CGHS) stores and Government Hospital, Nagpur, in India (Thawani et al, 2003) as well as Devnani et al (2010) who analyzed the pharmacy store of Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, also found in India.

Among the Class A medicines procured from MSD purchased items, Ceftriaxone injection (1 gram) which is a 3<sup>rd</sup> generation cephalosporin antibiotic ranked first by contributing 15.2 percentage total expenditures. This was followed by sodium chloride infusions, haloperidol tablets (antipsychotic) and halothane (a general anaesthetic) which all together contributed about 50% of the percentage total expenditures. For items purchased from the local suppliers purchased items; Meloxicam tablets(NSAID) was ranked first, followed by Augmentin tablets (antibiotic), glimepiride tablets(anti-diabetic), Meropenem injection(antibiotic) and Isoflurane liquid( a general anaesthetic). These 5 items contributed about 31% of the expenditures. For the case of isoflurane, being a general anaesthetic and MNH being a national referral hospital, a greater number of operations and surgeries undertaken may explain its high usage.

### **5.3 The Vital, Essential and Non-essential medicines (VEN) Analysis**

The VEN analysis of this study indicate that 50(34.97%) out of the 143 MSD purchased items were Vital medicines, 90(62.94%) items were Essential medicines and only 3(2.10%) of all the items were Non-essential medicines. This analysis is based on criticality of the medicines as far as health needs and priorities of the patients are concerned. There could be serious functional dislocation of patient care services in hospital when vital drugs are not available even for a short period. If essential items are not available beyond a few days or a week, the functioning of the hospital can be adversely affected. The shortage of non-essential items would not adversely affect patient care or hospital functioning even if it is prolonged. Moreover, for these purchased items, the 50 vital medicines costed about TZS 234 million, the 90 essential medicines consumed about TZS 535 million and the remaining 3 Non-essential items had a value of TZS 1.5 million. This is a similar observation as in the MSD procured items; most of the budget being consumed by the essential medicines which implies that the pharmacy department

management tried the best on ensuring that most of the budget is allocated for the vital and essential items rather than the non-essential ones.

On the purchases from local suppliers, about 21.5% of the items were non-essential medicines costing approximately 10% of the budget equivalent to TZS 42 million. The 7% vital items costed about 17% of the budget. The hospital could have tried to minimize purchase of the non-essential medicines and increase the amount of the vital items since these are for life saving purposes. This hospital being a national referral hospital, the vital items are crucial and must be present at greater amount as compared to the rest of the items. The findings of a study done by Devnani et al, 2010, are also similar to those of Thawani et al, 2003. Both of these are in complete agreement with the findings of the present study.

Chungsiwapornpong (2007) revealed that the percentage of stock out situations at hospitals using VEN analysis (0, 99%) was less compared to hospitals without this inventory classification (3, 94 %). Therefore this suggests that VEN analysis helps to prioritize procurement by basing on the vital and essential medicines, this has an implication on financial resources since most of the time funds are limited. Availability of vital and essential medicine items has an influence on the quality of healthcare of any hospital.

#### **5.4 Medicines requiring higher inventory control monitoring**

Combining the ABC and VEN analyses lead to categories of medicines that require different inventory control management. The essence is to narrow down the number of items requiring maximum supervision since there is no need of loading equal attention to the entire medicine inventory under the hospital custody. Category I had about 103 medicine items comprising the expensive (Class A) and the vital medicines. It is not realistic to devote maximum inventory control only on the Class A medicine items as this would compromise the vital and essential items of which some are expensive while others are cheap. Currently the MNH pharmacy department is not using the combined ABC-VEN tool in managing their inventory; this implies equal attention is exerted on all medicines. The pharmacy department management should dedicate higher supervisory effort on

inventory control of category I. The category II and III items require moderate and low degree of control respectively. However the significance of managing category II medicines is to ensure the availability of essential medicines which has an impact on the quality of pharmaceutical services provided.

Kant S et al. (1997) observed that ABC analysis for prioritization was an efficient technique for effective management of store in hospitals. They experienced an effective control of over two-third of the total expenditure by controlling only about one-fourth of the items. This is also supported by Thawani, et al. (2004) and Gupta, et al. (2007). According to Devnani et al, 2010, their findings showed that there 22% items in category I, 54.63% items in category II and 23% items in category III. The category I items required a tighter degree of control as compared to the rest. Findings by Gupta et al (2010) are also related to the present study, their study revealed that the ABC-VED matrix had category I comprising of 68 drugs, category II having 159 and Category III containing 98 drugs. These findings are also related to the study done by Thawani et al, 2004, in India and they emanate importance of this categorization.

### **5.5 Comparison of the estimated to the actual procured quantities of medicines for the financial year 2011/2012**

Out of 143 items procured from MSD, only 27.3% of the items were received same quantity as ordered. This was not a good observation as majority of the items (68.53%) the quantities received was less than the quantities ordered. Probably the reasons for this could be that MSD did not have enough of the items to suffice the hospital needs or funds allocated for medicines by the hospital were not enough. According to a report by Euro Health Group and MOHSW, 2007 showed that management of suppliers within the MSD has been weak and was identified to be an important part of the medicine logistics problem. Basing on contracts terms it was reported that less than 50 percent of medicine items arrive on time. This was justified by out-of stock experienced most of the time by many health facilities. Also most of the time they received fewer items than what they have order which applies to this present study.

There was an observation of about 4% items being received more than the quantity requested from MSD; the reasons for the hospital to receive more quantities than ordered could probably be that the items were short expiry so MSD decided to push the items to the facilities so that they do not expire in their store. This may be supported by the 2010/11 report of the Controller and Auditor General (CAG) which uncovered a series of shortcomings which pointed to the procurement and distribution systems failure. The report showed that 8 billion Tanzanian shillings worth of medicines had expired within MSD stores while at the same time facilities were experiencing shortages of key medicines. This is very challenging for resource constrained countries like Tanzania.

Most of the vital and essential medicine items were received less as compared to the quantity ordered. This has an implication on the pharmaceutical services provided by the hospital in terms of their availability, taking into consideration that this is a national hospital. The WHO insists on the presence of essential medicines by a hundred percent (100%) in all the health facilities, at all times (WHO, 1977). Conversely, for the local supplied items, majority (65%) of the ordered items for the particular financial year were procured as ordered, only 34% of the items being procured less than ordered, of which 35% of them were non-essential. This implies a fair management of the internal generated and the health insurance funds.

## **5.6 Methods of inventory control management used by the hospital and the challenges involved**

Muhimbili National Hospital pharmacy department uses a computerized, electronic drug record system (EDRS) equipped with JEEVA software. The system is designed such that different reports can be obtained, such as the daily dispensed items and quantities. The sub-pharmacies order their needs from the central main-store pharmacy and issue their medicines through this system. However the pharmaceutical personnel have to fill the bin cards of the respective pharmaceuticals, this implies at the end of the day the physical inventory has to reconcile with the computer system as well as the bin-cards.

The essence of a good inventory control is the supervision of supply, storage and accessibility of items in order to ensure an adequate supply without excessive oversupply. It captures aspects of selection and quantification of hospital needs as well as the management on the use of pharmaceutical items. This is an accounting procedure or system designed to promote efficiency or assure the implementation of a policy or safeguard pharmaceuticals so as avoid pilferage and errors.

Nevertheless, majority (94%) of the interviewee corresponded to the shortage of staff. This is also justified by the required staffing level for the pharmacy department as attached as Annex IV which shows that there is a deficit of 4 clinical pharmacists, 5 pharmacists and 19 pharmaceutical technicians

### **5.7 Knowledge of pharmaceutical personnel involved in inventory control management**

Concerning the knowledge on pharmaceutical inventory management, Majority (70%) also knew on the purpose of medicine inventory management. However most of the intern pharmacists respondents (85.7%) could not correctly explain the application of vital, essential and non-essential and non-essential analysis as far as inventory management is concerned. Also on being asked whether the interviewee knew about the methods of inventory control, most responded to know however on being asked to mention at least one method of it, majority could not correctly mention. Majority (80%) had an average level of knowledge on inventory management. Ideally for an effective pharmaceutical management, the personnel involved should acquire an intensive formal training and regular workshops or seminars related to the subject.

These findings are also supported by a study by Kagashe et al, 2012 who assessed the logistic skill levels of personnel involved in medicines supply as well as inventory management of medicines in public hospitals in Dar es Salaam region, Tanzania. They revealed that logistic skill level was poor in other health facility but it was fair for MNH. They recommended that personnel dealing with medicines supply should be trained in procurement and inventory management as most of the respondents appeared to have a fair knowledge. This also applies to this present study

## CHAPTER SIX

### 6.1 CONCLUSION

In the financial year 2011/2012, about two-third of the medicines were procured from local suppliers, this has an implication on the expenditures since local suppliers usually sell at higher prices compared to MSD which is a government agency. The proportion of the annual medicine expenditures to the total recurrent costs was approximately TZS billion 1.2 to TZS billion 92, which is only 1.3%. Most of the annual hospital budget was used for administrative purposes.

For the MSD procured medicines, 8 out of 143 items were found to consume about 50% of the budget. Ceftriaxone 1 gram injection alone had a percentage total value of 15%. For the local procured medicines, 14 out of 251 items consumed half the budget and meloxicam and augmentin tablets had percentage total value of 16%.

By using ABC and VEN analyses we were able to single-out medicines requiring higher inventory control. The Class A, B and C items were revealed to cost about 70%, 20% and 10% of the total medicine budget respectively. All medicine items were 17.0%, 68.5% and 14.5% according to VEN classification and most of these were essential medicine items which were not procured as ordered especially from MSD which could have affected the quality of pharmaceutical services provided.

## 6.2 RECOMMENDATIONS

1. The hospital pharmacy department should conduct the ABC and VEN analysis periodically so as to manage the medicine expenditures effectively and efficiently. It was found that only 10 out of the 394 items were vital items belonging to Class A. This emphasizes that priority setting and decision making in the procurement and purchase should be based on application of these scientific tools of inventory management (ABC and VEN tools). The pharmaceutical personnel should also be well acquainted on the importance and how to apply or use these tools.
2. Medicines budget should be increased comparatively from the total recurrent costs since it was only 1.3%. Most of the hospital budget was used for administration purposes. Review of the hospital general expenditures and funding allocation should be done.
3. Procurement/ Purchasing of pharmaceuticals should be based on a proper procurement plan that is obtained from reliable estimates of actual hospital needs. It should also ensure the availability of vital and essential medicines rather than non-essential. Because of the scarce financial resources a number of non-essential items should also be reduced. In this study 14.5% were non-essential medicines while only 17% were vital ones.

## REFERENCES

Blackburn, J: Fundamentals of purchasing and Inventory control for certified pharmacy technicians. MBA-Healthcare Administration. 2010. Pg 6

Chungsiwapornpong, W. (2007). Survey of drug inventory control process and performance among hospital pharmacy departments in Thailand. Retrieved December 4, 2012, from <http://www.li.mahidol.ac.th/thesis/2550/cd406/4836143.pdf>

Coyle J. Bardi J, Langley C. John Jr. (2003). The Management of Business Logistics: A Supply Chain Perspective. 7th edition. South-Western Thomson Learning.

Devnani M, Gupta A, Nigah R. ABC and VED Analysis of the Pharmacy Store of a Tertiary Care Teaching, Research and Referral Healthcare Institute of India J Young Pharm. 2010 Apr-Jun; 2(2): 201–205.

Dobler B, & Lee Jr L . (1990). Purchasing and Materials Management: Text and Cases 5th Edition. NY, New York: McGraw-Hill, Inc., 842.

Euro Health Group (2007) Drug Tracking Study Royal Danish Embassy, Dar es Salaam-Tanzania.

Gupta R, Gupta K , Jain B, Garg R. (2007). ABC and VED Analysis in Medical Stores Inventory. MJAFI;63: 325-327.

Kagashe, G & Massawe, T. (2012). Medicine stock out and inventory management problems in public hospitals in Tanzania. A case of Dar es salaam region. International Journal of Pharmacy, 2(2), 252–259.

Kaur J, Bapna, J. Bhoi N, & Singh, O. (2006). Management of Hospital Pharmacy in Private Sector. Journal of Health Management, 8(1), 1–10.

Kolenchic O, Bredneva N, Zevakova V. 2007. Pharmacoeconomic study of drug supply patients with multiple sclerosis. Pharmacy [Farmacija], in Russia, No.6, pp.23-25.

- Lambrelli D, & O'Donnell O. (2011). The impotence of price controls: failed attempts to constrain pharmaceutical expenditures in Greece. *Health policy (Amsterdam, Netherlands)*, 101(2), 162–71.
- Mahatme M, Dakhale G, Hiware S, Shinde A & Salve A. (2012). Medical store management: an integrated economic analysis of a tertiary care hospital in central India. *Journal of Young Pharmacists: JYP*, 4(2), 114–8.
- Manhas A, Malik A, Haroon R, Sheikh A, Syed A. (2012): Analysis of inventory of drug and pharmacy department of a tertiary care hospital. *JIMSA*. Vol 25 No. 3.
- Marcoux M, Simeone J, Colavita M, & Larrat E. (2012). An innovative approach to pharmacy management in a state correctional system. *Journal of correctional health care*, 18(1), 53–61.
- Ministry of Health and Social Welfare Report. (2008). In-depth assessment of the medicines supply in Tanzania. pp 1–88.
- Ministry of Health and Social Welfare Report.(2010). Tanzania health system assessment. pp. 1-110.
- Muhimbili National Hospital website Home page. 2013. [www.mnh.or.tz](http://www.mnh.or.tz)
- Murphy J, & Yemen S. (1986). Computer-assisted inventory control utilizing ABC inventory analysis and EOQ in a hospital pharmacy. *The Canadian journal of hospital pharmacy*, 39(6), 159–63. Retrieved December 4, 2012 from <http://www.ncbi.nlm.nih.gov/pubmed/10301177>
- Rasdorskaya I, Filina I (2008). Optimization of drug supply medical prophylactic offices in Orlov region. *Pharmacy [Farmacija]*, in Russian, No.4, pp.41-42.
- Rubin H, & Keller D. (1983). Improving a pharmaceutical purchasing and inventory control system. *American Journal of Hospital Pharmacy*, 40(1), 67–70. Retrieved December 4, 2012 from <http://www.ncbi.nlm.nih.gov/pubmed/6823991>

SIKIKI Report. (2011). Medicines and medical supplies availability (pp. 1–68).

Soares P. (1985). Quality assurance standards for purchasing and inventory control. *American journal of hospital pharmacy*, 42(3), 610–20. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/3985026>

Hamza T Report. (2006). Assessment of Pharmacy and Inventory Control in Ministry of Health Hospitals in Jordan, 1–178.

Thawani V, Turankar A, Sontakke S, Pimpalkhute S, Dakhale N, & Jaiswal K. (2004). Economic analysis of drug expenditure in Government Medical College hospital, Nagpur, India *Journal of Pharmacology*, 36(1), 15–19.

Tumwine Y, Kutuyabami P, Odoi A, Kalyango N. Availability and expiry of essential medicines and supplies during the "pull" and "push" drug acquisition systems in a rural Ugandan hospital. *Tropical Journal of Pharmaceutical Research*, 2010; 9(6): 557-564. Available online at <http://www.tjpr.org>

United Republic of Tanzania (2008). *The Economic Survey*. Tanzania Government printer, Dar es Salaam, Tanzania.

Vaz F, Ferreira A, Kulkarni M, Motghare D, Perreira-Antao, I (2008): A study of drug expenditures at a Tertiary care hospital: An ABC-VED Analysis. *Journal of Health Management*. 10:119

WHO. Studying the pharmaceutical area. . *Health action in crises* [cited 2010 Feb]; Available from: <http://www.who.int/hac/techguidance/tools/disr>

WHO. The selection of essential drugs. Report of the WHO Expert Committee. Technical Report Series No 615. Geneva; WHO: 1977

Wilson, S. (1995). Inventory management to reduce costs: a case study. *Hospital Pharmacy*,30(9), 759–61, 765–6. Retrieved December 4, 2012 from <http://www.ncbi.nlm.nih.gov/pubmed/10151280>

**ANNEXES****ANNEX I****QUESTIONNAIRE****ANALYSIS OF MEDICINE EXPENDITURES AND PHARMACEUTICAL  
INVENTORY CONTROL MANAGEMENT AT MUHIMBILI NATIONAL HOSPITAL**

Questionnaire no. \_\_\_\_\_

Date of interview \_\_\_\_\_

**PART A: Social- Demographic data**

1. Gender: a. Male b. Female
2. Age: a. 20-29 b. 30-39 c. 40-49 d. 50-59
3. Educational level:
  - a. Certificate b. diploma c. advanced diploma d. Degree e. others  
(specify) \_\_\_\_\_
4. Job title: \_\_\_\_\_
5. Work experience: \_\_\_\_\_

**PART B:**

6. Have you heard of the following concepts, as far as inventory management of pharmaceuticals is concerned?
 

a. VEN analysis	Yes	No
b. Economic order quantity	Yes	No
c. Safety stock	Yes	No
d. Review period	Yes	No

7. If the answer(s) of any of the above is / are Yes, Where did you learn about these?
- a. Formal training                      b. On-job training                      c. Others(mention)\_\_\_\_\_
8. The purpose of a medicine inventory management system is to know
- a. When to order stock                      Yes      No
- b. When to issue stock                      Yes      No
- c. How much stock to order                      Yes      No
- d. How much to issue                      Yes      No
- e. What inventory level to maintain in order to avoid shortages.      Yes      No
9. Do you know the application or use of concepts of Vital, Essential, Non essential classification as well as ABC analysis of medicines in inventory control management?
- a. Yes                      b. No
10. If the answer is yes, what is their use?\_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- 11.
12. Do you know about the methods of inventory control?
- a. Yes                      b. No
13. If the answer is Yes, mention at least one type of inventory control methods
- \_\_\_\_\_
14. Do you have a predetermined time for ordering medicines from the main store?
- a. Yes                      b. No
15. Are there written standard operating procedures for inventory management that you use?
- a. Yes                      b. No

16. Are you involved in assessing and estimating the quantities of medicines required per year?

- a. Yes
- b. No

17. What methods do you use in keeping records for the inventory control management?

- a. EDRS (Electronic drug record system.)
- b. Bin cards
- c. ledgers
- d. all the three

e. Others( specify)\_\_\_\_\_

18. Do you have any problems with using the above methods of keeping records?

- a. Yes
- b. No

19. If the answer is Yes, what problems do you face?

\_\_\_\_\_

20. What are the challenges that you encounter in pharmaceutical inventory management?

\_\_\_\_\_

21. What particular area(s) would you like to have training as far as medicine inventory control management is concerned?

\_\_\_\_\_  
\_\_\_\_\_

## **ANNEX II**

### **CONSENT FORM (FOR IN-DEPTH INTERVIEW OF KEY INFORMANTS)**

CONSENT TO PARTICIPATE IN A STUDY TO CONDUCT ANALYSIS OF MEDICINES EXPENDITURES AND ASSESS INVENTORY MANAGEMENT AT MUHIMBILI NATIONAL HOSPITAL (MNH)

Hallo!

I am TUMAINI LYOMBE, a Masters Student from Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MSc. Pharmaceutical Management

#### **Purpose of the Study**

This study aims to conduct analysis of the annual medicines expenditures using ABC and VEN analysis, identify a list of medicines purchased per year and categorize medicines requiring high inventory control monitoring and lastly to identify methods of inventory management used and the challenges involved.

#### **Participation**

If you agree to join the study, you will be required to answer all the questions that will be asked by the researcher

#### **Confidentiality**

Information obtained from you will be treated with confidentiality and will NEVER be used for any other purpose other than this study

#### **Risk**

No harm is expected to happen to anyone participating in this study

**Benefits**

Your participation in this study will provide us with data that will be used in proposing areas of improvement concerning medicine expenditures and hence will be useful in a formation of a strengthened fund and inventory management as far as medicines procurement is concerned

**Who to Contact**

For any questions about this study, do not hesitate to contact the following:

Tumaini Lyombe (Researcher)  
School of Pharmacy,  
Muhimbili University of Health and Allied Sciences,  
P.O. Box 65001, Dar es Salaam.  
Mobile phone: 0713 500303

OR

Prof M Justin-Temu (Research Supervisor)  
School of Pharmacy,  
Muhimbili University of Health and Allied Sciences,  
P.O. Box 65013, Dar es Salaam.  
Mobile phone: 0715320558

Also, if you will have questions about your rights as a participant, you may contact Prof Mainen Moshi, Director of Research and Publications (MUHAS), P.O. Bo65001, Dar es Salaam. Tel: 2150302-6.

If you agree to participate in this study write the word YES \_\_\_\_\_

Signature of participant \_\_\_\_\_

Signature of researcher \_\_\_\_\_

Date of signed consent \_\_\_\_\_

**ANNEX III****CONSENT FORM (Swahili version)**

FOMU YA KUKUBALI KUJIUNGA KWA HIARI KATIKA UTAFITI KUHUSU UCHUNGUZI WA MATUMIZI YA FEDHA ZINAZONUNULIA MADAWA NA MENEJIMENTI YA MALI YA DAWA KATIKA HOSPITALI YA RUFAA YA TAIFA YA MUHIMBILI

Habari!

Ninaitwa TUMAINI LYOMBE, mwanafunzi wa Shahada ya Uzamili ya Menejimenti ya Famasi kutoka Chuo Kikuu cha Sayansi za Afya Shirikishi Muhimbili.

**Malengo ya utafiti:**

Huu utafiti unalenga kufanya uchunguzi juu ya matumizi ya fedha zinazonunulia madawa kwa kutumia mifumo ya uchunguzi ya ABC na VEN, kugawanya madawa katika makundi kulingana na uhitaji wa uangalizi makini na pia kuangalia njia zinazotumika katika menejiment ya madawa na changamoto zinazojitokeza

**Ushiriki katika utafiti:**

Kwa kushiriki katika utafiti huu utatakiwa kujibu maswali yote utakayoulizwa na mtafiti.

**Usiri:**

Taarifa zitakazopatikana kutoka kwako zitakuwa ni siri na HAZITATUMIKA mahali pengine popote isipokuwa katika utafiti huu tu.

**Madhara:**

Hatutegemei jambo lolote baya kutokea kwa mshiriki yoyote katika utafiti huu

**Faida za utafiti:**

Ukikubali kujiunga na utafiti utakuwa mmojawapo wa wale watakaofanikisha kutoa taarifa na hivyo kuboresha maeneo muhimu katika fedha zinazotumika kununulia madawa

na hivyo kuimarisha menejimenti ya fedha na madawa hasa kwa kuhusisha mfumo wa manunuzi ya madawa.

**Mawasiliano:**

Kama una swali lolote kuhusu utafiti huu tafadhali wasiliana na:

Tumaini Lyombe (Mtafiti Mkuu),  
Shule ya Famasi,  
Chuo Kikuu cha Sayansi za Afya ,Muhimbili,  
S.L.P 65001, Dar es salaam  
Simu ya mkononi : 0713500303

**AU**

Profesa M Justin- Temu,  
Shule ya Famasi,  
Chuo Kikuu cha Sayansi za Afya, Muhimbili  
S.L.P 65001, Dar es salaam,  
Simu ya mkononi: 0715320558

Pia kwa maswali yoyote kuhusu haki zako kama mshiriki katika utafiti huu wasiliana na

Profesa Mainen Moshi,  
Mwenyekiti wa Kamati ya Utafiti na Uchapishaji,  
Chuo kikuu cha Afya na Sayansi ya Tiba, S.L.P 65001, Dar es Salaam.  
Simu: 2150302-6.  
Kama umekubali kushiriki katika utafiti huu andika neno NDIO \_\_\_\_\_

Sahihi ya mshiriki\_\_\_\_\_

Sahihi ya mtafiti\_\_\_\_\_

Tarehe ya kusaini\_\_\_\_\_

**ANNEX IV**

The recommended staffing for the Pharmacy Department is as shown in the table below:

<b>S/N</b>	<b>Cadre</b>	<b>Available</b>	<b>Required staffing level</b>	<b>Deficit for employment</b>
<b>1</b>	Clinical Pharmacists	2	6	4
<b>2</b>	Pharmacists	12	17	5
<b>3</b>	Pharmaceutical Technicians	19	38	19
<b>4</b>	Medical Attendants	7	11	4
<b>5</b>	Office Secretary	1	1	0
<b>6</b>	Office Messenger	1	1	0
	<b>Total</b>	<b>42</b>	<b>74</b>	<b>32</b>

Source: Head, MNH pharmacy department